The Effectiveness of Applying Artificial Intelligence in Recruitment in Private Sectors

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Abstract. Companies seek for improving quality in order to survive in the competitive market. To survive, you must search for the right candidates and hire them in the best-fit position at the right time. Due to the rapid development in the world, several methods (traditional methods) are no longer efficient. People and companies are looking forward deploying more efficient methods in recruiting candidates. Currently, the trend in recruitment is moving forward applying artificial intelligence. This paper focus on impact of Artificial intelligence (AI) on private sectors. Since this industry is introduced recently, various companies are interested in applying AI. But the dilemma is that the advantages and disadvantages of applying AI in HR is still not commonly known for all of them. Also, the long-term effects for this industry still not revealed.

Keywords: HRM · E-HRM · E-recruitment · Artificial intelligence · Digital recruitment · AI in recruitment · Artificial intelligence in recruitment

1 Introduction

What is the most important element when considering evaluating a corporate's value? The criteria of evaluating the resources and values of companies have changed since the beginning of the eighties of the last century [1]. Previously, evaluation depended on tangible resources such as lands, Factories and equipment with a rate ranging from 70% to 90%. In the beginning of the current century, intangible resources cover about more than 60% of average firms' value [1]. As a result of this change, recruitment turned out to be an extensive concern for HR and CEOs over the last years [1].

Due to the effects of the forth industrial revolution, since we live in the beginning of it, Human resource management was enforced to take a step forward into dealing with their concern which was the manpower that plays the most important role in the performance for organization. Hiring qualified candidates who his/her qualifications and skills match with strategy of the firm and the required position is considered to be the most challenging task overall human resource management activities. According to Edwin B.

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Flippo, "Recruitment is the process of searching of the candidates for employment and stimulating them to apply for jobs in the organization" [13].

Recruitment is a responsibility for human resource management (HRM) and it is accomplished through two aspects; inter and external. Internal recruitment. Internal recruitment occurs inside the firm by advertising the vacancy to the employees therefore employees apply for it then he/she will be transfered to that position or by giving a chance for an employee to get promoted for that vacancy. While external recruitment is basically attracting external candidates who looks forward to be hired to the vacancy by publishing required skill and experience through the public media. At the end, Human recourse manager decides whether a candidate fits for the job role or not [13].

At present, recruitment is mainly achieved by recruiters who sit and search for specific applicants through available sources. Recruiters are in charge of carrying out all steps required such as contacting candidates, rejecting applicants, conducting interviews, etc. Due to the time those steps take and limitation of human being, it is not easy to follow up with all tasks. In addition, human being constraints such as prejudices, time limits and pre-concepts represent obstacles for impartial and efficient recruitment. Therefore, firms are obligated to solve this issue since this lead them to lose the most desirable applicants which are more valuable resources for firms. Developing efficient methods becomes essential based on the previous reasons (roy setiawan 2021). As result, recruitment practices and methods has been changed by technology via using multimedia tools, online applicant tracking system and self-learning computing systems. Moreover, these developments in recruitment led to emerging the term artificial intelligence in recruitment [1].

1.1 Research Problem

The HR sector is rapidly developing. This rapid transformation is introducing new challenges to organizations and the whole industry. This fast development is raising new difficulties to companies as well as the whole sector. The organization has to deploy new solutions to meet the market's requirements as existing process are not efficient. New approaches offered by artificial intelligences can help organization to overcome these challenges.

1.2 Research Objectives

The main objective for this paper is to encourage companies and people to invest more in AI recruitment by

- To define E-HRM and Digital recruitment.
- To define artificial intelligence in general.
- To define artificial intelligence in recruitment.
- To show advantages and challenges in AI recruitment.

2 Literature Review

2.1 E-HRM

According to Sbhi, Hanan and Bzar [8] Human resources (HR) was introduced in 1960s as management regulation. Human resource management (HRM) can be defined as management of workforce [8]. Based on RJ Stone, A Cox, M Gavin [6] human resource management concentrates on how to manage the relationship between employee-employer. Human resource managements organizes and impede shortage in workforce of corporations via stimulating older worker to keep working until a large age and preparing younger workers to substitute the older workers which results in reducing retirement costs and work continuity [7]. In order for organization to fit with quick internal or external changes, organizations moved forward using HRM with help of technology tools which results in a term called HRIS [8]. HRIS stands for Human Resource information system which uses technology tools in order to achieve human resource management functions [8].

Thereafter, due to enhancements in human resource practices, Electronic Human Resource Management (E-HRM) has substituted HRIS. The term E-HRM was raised in 1990s means implying automating management and employee services [8]. E-HRM can be referred as 'Web-based HRM', 'Virtual HRM', 'electronic HRM', 'HRIT', 'computer-based HRM' and 'digital HRM' [8]. E-HRM can be expressed as "the application of computers and telecommunication devices to collect, store, retrieve and disseminate human resource date for business purposes" [8].

According to Al-kasasbeh, Omar and Halim [9], information technology is used by E-HRM in two approaches; first, Technology is essential to link users that are geographically distant and allow them to communicate regardless of where they are; even if they are in the same room or working in separate spots of the world. To clarify, technology serves HRM by establishing the connecting environment. According to that, e-HRM has the ability to improve the services given to HR department clients (both employees and management), increase efficiency and cost-effectiveness in the HR department, and allow HR to turn into a strategic partner that contributes to the fulfillment of organizational goals. Second, e-HRM is indeed a tool used to provide management solutions that contribute to human resources effectiveness, such as E-recruitment, appraisal, E-selection, E-performance, E-training, E-compensation and E-communication [9].

Additionally, Al-kasasbeh, Omar and Halim [9] explain how technology is involved in the solutions offered by E-HRM to HR department as the following: 1) E-recruitment: is used by to advertise vacancy and building application for applying to that vacancy. 2) E-selection: internet is useful in selection process especially for applicants who lives in a widely far spot. 3) E-Compensation: tools provide higher access to information for managers in which may result in increasing effectiveness in compensation. 4) E-training: technology provides material such as laptop, PC, E-books, etc. and media players. 5) E-performance appraisal: technology contribution in performance appraisable is tangible in two practices; monitoring employees' computer performance unobtrusively in an automated method that requires minimum input from individuals over their work

performance and through writing and providing employees' performance feedback. 6) E-communication: which can be clearly noticed in using Emails as a tool of communication in more than 75% in corporative companies.

Performance expectancy, effort expectancy, and peer pressure are the deciding factors of e-HRM [10]. Al-haideri and Siam [10] define performance expectancy as the number of goals and objectives that a client is expecting to achieve via using the framework. Whilst, effort expectancy, the second E-HRM determining factors; the extent to which comfort is tied to framework utilization. Lastly, Peer pressure can be defined as "how much one perceives it important to use the new framework because others are doing" [10].

The benefits of using E-HRM is to ensure availability in HR functions for employees and managers [8]. As a result, E-HRM has been employed in a variety of industries, including the healthcare industry as a web-based electronic hospital system and education for learning purposes [8]. Using E-HRM solutions increases HR flexibility, strategy, cost-effectivity; it also improves decision-making, reduces response time, minimizes operational effort, increases productivity, and improves client service [8].

However, Although E-HRM has shown potential in development HR process, 90% of basic organizational information management system refused to use E-HRM in Phuket hotels while only 10% agreed [8]. The literature on e-HRM has revealed that the use of e-HRM is dependent on the use of technology as a base element, as well as the acceptance model of technology [10]. Based on Al-Haidari and Siam [10] a study has shown that if the use of the HRM system is aligned with the system's suggested motivation and its facilitation condition, it may be gradually coupled to the e-HRM system. Whilst There have been several studies on e-HRM, but it has yet to be determined if it is effective or not, various techniques can define the effectiveness of HRM in employee satisfaction and commitment [10].

2.2 Digital Recruitment

2.2.1 Digital Recruitment 1.0

In the mid-to-late 1990s, digital recruitment via the internet has created an enormous revolution for both applicants and employers [1]. Monstors.com; early digital recruitment portals; started in 1994 attracted thousands of recruiters to publish plentiful vacancy details due to the lower cost since the cost of printing and publishing job ads through newspapers was avoided [1]. The relationship between Monster.com applicants and jobs were directly potential meaning increasing in jobs offered in Monters.com led to increasing in attracted candidates. The more job seekers applied, the more job were listed [1].

The process was as simple as the recruiters explored the CVs in the portal after that they filtered and sorted them then they selected the job seekers who were best-fit for the company's perspective. Likewise, applicants saved time and efforts in reviewing printing job ads, contacting firms, mailing firms, and sending resumes [1]. Based on Rosoiu, O., & Popescu, C [11] online recruitment process is 70% faster than the traditional method. The internet also allowed businesses to reach out to thousands of potential workers through corporate websites. They-might-incorporate as much static and dynamic information as

they thought would be beneficial [1]. In addition, digital recruitment removed borders between countries and allowed job seekers to apply for several jobs in several areas [11].

However, according to Campus, Arrazola and Hevia [12] the performance of job portals is was determined by four main attributes: 1) the amount of information gathered about candidates; 2) the amount of information available for job seekers in a portal; 3) the cost of portals; 4) the undetected quality of applicants that necessitates the firm's need to screen job candidates further. In fact, Person–environment (P–E) fit theories proposed that when potential applicants see a fit or match with the organization, they will have a good attitude toward recruiting material provided on job portals [12]. Job seekers matches the description in job portal with their skills to assess whether they fit for a company or not.

As a result of enormous outcomes job portals brought, companies abounded the old practice of recruitments (analog recruitment) and shifted toward online recruitment since it allowed them reaching various applicants [1]. Based on to Campus, Arrazola and Hevia [12], 90% of large companies in the United States of America use online recruitment in the last decade. The value digital recruitment offered for both recruiters and candidates during the decade led to establish new cooperation and new job boards proliferated [1]. For example, Monsters.com revenue in 2006 was $1.1 while in 1996 was 162.6 million [1].

2.2.2 Digital Recruitment 2.0

After one decade of the beginning of Digital Recruitment 1.0, Digital Recruitment 2.0 has been introduced to the public [1]. As mentioned by Bohmova [5] Digital Recruitment 2.0 can be defined as "a process of hiring new employees with the use of social media such as LinkedIn, Face book, Google +, Twitter and many other social media sites". There were two main advantages that digital recruitment 2.0 has over 1.0. First, it allow job seekers to explore several job platforms [1]. In other words, applicants have the ability to search for different jobs offered in multiple job portals without the need for visiting each one. Likewise, Companies may reach out to unique job seekers across all recruiting sites without having to post their offers on each one separately. Second, the appearance of digital professional and social network platforms [1].

With so many possibilities accessible in this day of plentiful Internet and social media, choosing which sourcing tool to use in the recruitment task becomes a vital decision for any firm or recruiter [4]. Social platforms benefit recruiters in two ways; 1) they are used to find and attract passive and semi passive job seekers [4, 5] 2) "posts per week" which means how the company interact with its followers in the platform [5]. In 2017, 93% of recruiters were using social media for recruiting purposes [4] compared to 80% in 2012 [5]. However, social media websites differ in popularity from geographical area to another [5].

LinkedIn was one of the first and most well-known professional networking platforms. LinkedIn, launched in 2003, allows users to endorse others in their network, and get endorsement from others in their networks, develop, exchange information and professional networks and communities of interest [1]. Statistics shows that in 2012 LinkedIn users reached up to 332 million member over 200 countries [5]. Whilst, in 2017 linked had 3 million job listing and 467 million users [4]. In fact, 95% of recruiters

were using LinkedIn for recruiting processes [4]. Indeed, the popularity that LinkedIn gained because of the ability in LinkedIn to build professionals relations as it was being seen by the public [4].

On the other hand, Twitter and Facebook were as high use as LinkedIn since they were more general social media [4]. Members of Facebook may expand their network by 'friending' other individuals and keep them up to date by publishing images and videos [1]. While Twitter is considered as microblogging platform allowing members to communicate within 140 characters for each tweet [4]. Studies show that 66% of recruiters were using Facebook in 2014 while 52% for Twitter [4].

2.2.3 Digital Recruitment 3.0

Digital recruitment was introduced after 2.0 and the main advantage in this type of recruitment is inserting artificial intelligence in the process of recruitment [1] which will be reviewed in this paper.

2.3 Artificial Intelligence

Artificial intelligence (AI) is a constantly dynamic frontier of developing computing capabilities, not a technology or group of technologies [3]. AI does not have a single definition and can take on a variety of meanings according on its context, applications, and intelligence [15]. Further, AI may be described as a system that can comprehend and learn from external inputs in order to achieve certain goals by adapting to the circumstances [15]. Whilst, Kot [Kot] defines AI as a broad class of computer-based technology that supports various business tasks with human-like intelligence for prosperous higher intellectual process. In general, AI may be defined as a system that simulates typical humanistic behavior such as learning, speaking, and problem-solving, causing it to act similarly to an intelligent person [15]. According to the definition, it is clearly that AI not only provide solution for problems with fast analyze and response but also have the ability to mimic and increase human-like intelligence which include cognitive, emotional, and social competences [15].

The machine learning technologies that are at the core of contemporary AI have greater autonomy, deeper learning capacity, and are more inscrutable than any of the "intelligent" IT artifacts that have made before [3]. Current AI technologies, such as robotics and autonomous vehicles, facial detection, natural language processing, and various types of virtual agents, are being used in a broad range of problem areas [3]. An estimations on AI states that in 2020 more than half of enterprises were employing some kind of this new wave of technology and the applications are growing at an incredible rate [3]. These advancements are significant because AI has limitless potential for improving people's lives in a wide range of domains, including their homes, medical, education, career, entertainment, safety, and transportation. AI offers businesses unparalleled prospects for developing intelligent goods, developing unique service offerings, and developing new business opportunities and organizational structures [3].

Advanced technology such as Artificial intelligence has three principles in order to be understood; Combinations, recursiveness and phenomena [2]. First, combinations

means machine learning depends on improved performance-price ratio of computer-processing technology, data storage and management. By combining these factors, it results in making AI a significant tool for producing products, service or platform [2]. Second, AI implementation structures modular architecture forming complicated network of technologies where each technology is enhanced independently according to it is goals [2]. In addition, AI is a set of technologies that are set of technologies. Changing or improvement in a segment of technology may lead to a conflict of other's objectives [2]. For Example, enhancements in a service recommendation engine leads to enhancements to its convenience, personalization and ease of use [2]. Lastly, third principles, Phenomena; today's AI has data-driven learning at its center. For instance, a type of machine learning algorithms are able to teach themselves how to recognize a dog or a cat if trained with pre labeled set depending on how big the data is without setting explicit rules for recognizing [2].

Furthermore, intelligence-based AI systems may be divided into three types: analytical, human-inspired, and humanized AI [15]. Analytical AI with cognitive intelligence has the ability to make future judgments based on previous data learning and analysis, which might be used in Virtual teaching fraud detection, assistance, photo identification, and other applications [15]. Human-inspired AI can recognize and assess human emotions such as anger, enthusiasm, and so on, which impacts their decision-making. Virtual recruiters, for example, recognize a candidate's emotions during the selection process [15]. Humanized AI combines all three cognitive, social, and emotional abilities.

Aside from the benefits of AI, there are other obstacles that must be addressed. Data problems, political, legal, and regulatory obstacles, and ethical issues are among them. As AI requires a big quantity of data, issues such as transparency, low quality, unavailability of data gathering format, data discontinuity and lack of data availability and so on pose important obstacles [15]. To protect people's privacy and safety, the government must develop a legal framework that achieve a balance between AI data and public privacy [15]. Because AI requires a massive quantity of data, rigid laws and regulations may stymie its application. As per the European GDPR (General data protection standards) enacted in 2018, businesses must take great care while handling and transacting personal data, which may affect the freedom of utilizing data in AI. It is critical to preserve ethical purpose while obtaining public data from social media or other private sources. AI ethical issues are caused by moral quandaries, discrimination and biased decisions made by AI, appropriateness, and compatibility between a person and a computer [15].

2.4 Artificial Intelligence in Recruitment

Applying Digital Recruitment 2.0 in large companies ended up in a huge number of accumulated CV's and choosing the best fit applicants created a challenge for the firm [15]. Not reviewing candidates' application was costly, but also there was a probability of human bias in selecting candidates [15]. Thus, the need to overcome these obstacles required applying AI digital solutions since they are more efficient than human-being abilities [15].

AI in recruiting became widely employed in enterprises in 2018 and has been a significant trend to this day [15]. AI technologies were used at almost every stage of the

recruiting process, which revolutionized the recruitment market in a more novel way and gave a huge aid in selecting the top applicants from big pools of varied aspirants [15]. These tools were effective in a variety of ways, including producing job descriptions with appropriate terminology and language that is bias-free, gender-neutral, and targets a specific set of candidates [15]. For instance, L'Oreal used AI to eliminate gender bias language in their advertisements, allowing them to hire an equal number of male and female candidates [15].

Based on Geetha AI improve and develop recruitment process in 8 steps; 1) screening candidates: by using chatbot [13] or CV screening tool ATS (applicant tracking system) which assess candidates profile based on keyword specified by recruiter [15]. 2) Candidate engagement: AI tools response to aspirants via auto email generated or messaging system. 3) Re-engagement. 4) Post-offer acceptance. 5) New hire on-boarding: It is beneficial to new recruits since it presents the organization's policies, processes, and cultures. All of these formal procedures may be answered by AI tools for applicants, and it also assists new recruits with knowledge and resources that link to current programs. 6) Career development. 7) Employee relation. 8) Scheduling.

Moreover, AI improve recruitment process via several tools and systems such as chatbot [Ayes]. AI-powered chatbot are increasingly becoming popular in the recruiting market. These chatbots can connect with applicants, answer their questions 24 h a day, and provide real-time and personalized interaction via text message, email, social media, and other channels. AI-powered chatbots are trained and prepared by using human natural language in order to communicate with candidates like humans via using emotion, contextual words and shorthand [15]. Also, video chat analysis such as Affectiva, HireIQ and HireVue, is widely used during interviews to analyze candidates' characteristic and performance such as tone, words-used, emotions, cadence, etc. [15].

Ayesha [15] believes that by assigning the routine tasks of screening to AI, recruiters will be able to stay focused on more strategic and creative matters in their daily routines, while HR managers will switch their focus from operational functions to a management role, motivating and cultivating the potential of their teams. According to Hmoud and Laszlo [14], administrative routine jobs will be gradually replaced by clever AI technology, allowing recruiters and HR managers to focus more on strategic activities.

The advancement of AI offers potential options for recruiters to maximize talent acquisition by automating time-consuming repetitive operations such as sourcing and screening applications, to improve the recruiting process's quality, and to minimize biased – human deception. According to Ayesha [15], these benefits stem from AI's ability to process information and make decisions at volumes and speeds far exceeding human capacity, as well as the availability of AI-enabled recruiting tools and systems that overcome common cognitive biases that undermine the reliability and validity of human judgment in recruiting activities.

Also, AI tools significantly reduce time in recruitment process especially in screening. For example, Ideal AI solutions provider claims that enabling AI tools decreases time to hire by 62% (from 24 days to 9 days). In addition, Hilton Hotels decrease their time to hire by 88% (52 days to 5 days) after applying AI screening tools. Lastly, L'Ore'al deployed AI-enabled screening technologies, and the time it took to evaluate a resume was reduced by 90%, from 40 min to 4 min [1]. In fact, as consequence of reducing time

in recruitment process with help of AI tools, hiring cost becomes cheaper for companies [15]. Since numbers of applicants are increasing and evaluating and screening process are becoming more complicated, a company would hire a huge number of recruiters in order to help the company choosing the right talented candidate. Thus, the company has no choice other than applying AI recruitment.

Bias recruitment represents a huge issue for efficiency in old-fashioned recruitment. Human biases are possible during the screening step of recruiting, however AI eliminates these prejudices and provides promising alternatives for acquiring right personnel. AI may eliminate human prejudices by using algorithms that disregard biases such as color, name, gender, school or university attended, and so on. On the other side, it filters candidates based on data provided to it such as qualification, abilities, and experience, among other things. Thus, AI is based on facts, and no emotions or sympathies may influence its evaluation [15].

In addition, AI recruitment can enhance decision making for human resource managers. Ayesha [15] states that Data analytics technologies are essential for making better decisions and forecasts about prospects. According to Geetha and Reddy [13] AI packages aid in the screening and selection of qualified candidates. It aids in identifying candidates' talents, competencies, and characteristics that are relevant to the position being applied for. As a consequence, a talented individual is hired.

However, in order to apply achieve impartial and bias-free recruitment, AI tools' algorithms must not only built and written in an efficient way but they must be transparent and available for inspection. Ayesh [15] says that if a company apply AI tools thus, it is necessary to demonstrate openness and transparency in how the algorithms are built and how they work to choose a candidate. Thus, in a scenario like this, a candidate will always feel justice why he/she were rejected. Ayesh also adds rejected applicants, who had a great experience when they were rejected, are more likely to be open to a future chance.

Besides the advantages that AI recruitment brings to human resource management, there server risks and challenges are raised in applying and moving forward to AI. One of the main challenges is lack of knowledge [15]. Since AI recruitment applied 2018, a lot of companies are in the early stages of implementing AI therefore many tools are still unknown to HR experts. If recruiters do not know how to use the system or how algorithms are built, they would doubt and reject the solution. Since AI tools are not error-free, recruiters must explain how fairness and efficient their tools to the candidates otherwise they may lose candidates' trust [15].

Additionally, among the most frequently mentioned and essential problems of employing AI in the recruiting process is ensuring data protection and taking adequate precautions against ethical concerns. Recruiters might obtain personal information that is not directly relevant to recruiting by using various technologies utilized in the recruitment process. Age, health, body image, gender, sexual orientation, and other factors, for example, can be utilized to classify applicants and even discriminate when possible. The collection of this additional information may raise ethical and privacy concerns [15].

According to Ayesha [15] some studies show that a decent number of candidates do not trust machines recruitment functionality. The applicants always believe that human touch is significant at any phase of the hiring process, and they are convenient interacting

with a human during the interview. Not only candidates, but also HR recruiter's feels that AI recruitment tools is a threat for their job. Companies used to hire employees more than they fire which is not the situation in the current time [16]. However, AI tools cannot be left working alone without observation from humans [15].

Lastly, poor quality data and bias input represent challenges for HR managers. Since AI tools output is generated according the input [15], a poor input definitely results in an inappropriate output which has nothing to do with the machine's efficiency or the algorithm that runs it. For instance, Because of the biased input data given into the system in amazon, the computer trained itself to be prejudiced, causing it to punish female candidates despite having enough qualification [15].

3 Conclusion

Recruitment process is one of the main challenging and important practice in HR since worker represent more than 60% of companies' value [1]. Previously, recruiters had to advertise job vacancy through traditional ways such as newspapers, reviewing profiles and selecting candidates which was considered to a costly and long procedure. After that, a big leap was brought to HR recruitment process by moving to digital recruitment through websites and social media platforms such as monster.com, Facebook and LinkedIn [1]. According to huge numbers of candidates' profiles to be reviewed by recruiters which costs time and an effort, the need for more efficient method was emerged.

Artificial intelligence is a machine or tool that can act like human via learning by its self and generated results according to input from human. AI tools in recruitment such as ATS, Chatbot and video chat analysis can be developed and involved in every step of recruitment process [15]. In order for AI tools to be applied efficiently and impartial, they must be transparent for candidates and available for inspection. AI shows several benefits for HR managers in recruitment such as reducing cost, reducing time especially in screening CVs, bias-free recruitment, making HR managers more professionals, better decision making and making job applicants experience smooth and positive. In contrast, several challenges and risks must be considered when applying AI in recruitment such as lack of knowledge, bias-input, poor quality data, collaboration cost, losing jobs, machine trust and ethical issues like privacy [15].

Despite the risks and obstacles of AI recruiting, many firms have had success with their AI deployment. According to Ayesha [15], Okolie observed that enterprises benefitted from lower expenditures, more applications, and better applicant matching with individuals having a smoother application procedure, a diverse range of career possibilities, and, finally, a greater response rate from the organization to get feedback. She also claims that when Google launched the Cloud Jobs project, some of its clients, including Johnson & Johnson and FedEx, started using it to enhance interaction with potential applicants in their recruitment platforms, as well as to increase visibility and matching likelihood for job searchers. On the other hand, some companies faced issues in implementing AI tools such as Amazon [15].

Eventually, artificial intelligence leads to employee satisfaction and engagement. Furthermore, it contributes to a lower staff turnover and ensures that the organization

receives good service. The applications in the recruiting process are promising, and the growing demand for these tools with new capabilities makes it even more so. Despite the fact that AI decrease number of jobs causing some people to be fired, the touch of humans will always be needed and therefore it will generate new types of jobs and business. Since this field is considerably recent, the number of conducted studies on AI recruitment are not sufficient. Thus, methods are not widely employed in the recruiting industry. So there are many things to learn in order to seamlessly integrate and adapt to these new technology.

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