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WILL ARTIFICIAL INTELLIGENCE TAKE OVER HUMANRESOURCES RECRUITMENT AND SELECTION?

Review Article

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Abstract

There has been an emerging trend of utilizing Artificial Intelligence (AI) technologies within the business environment throughout the last two decades. This paper presents the position of the Human Resources recruitment and selection, an aspect of HR management, regarding incorporating AI solutions. The paper addresses the following questions: To what extent will humans use AI to hire humans? To what extent and how will AI affect recruiters' jobs? What are organizations' and HR managers' roles in this transformation? To this end, a set of literature and proposed models as well as examples of most commonly used temporary artificial intelligence solutions for the acquisition of Human resources have been reviewed to analyze and understand the previous contribution. It has been concluded that AI provides promising solutions for recruiters to optimize talent acquisition by taking over time-consuming repetitive tasks such as sourcing and screening applicants, to improve the quality of the hiring process and neutralize human biases. Augmented intelligence will be used widely and increasingly to produce better and more effective results; as a result, routine administrative jobs will be replaced by smart AI technologies and will gradually disappear.

INTRODUCTION

Since its emergence, Human Resources Management (HRM) has been subject to many factors that have changed its conduct. Globalization, information technology and recent social trends added more pressure on organizations to redefine themselves and update instantly in order to maintain their competitive advantages. The heterogeneous modern technologies such as Artificial Intelligence (AI) solutions changed jobs, which put pressure on Human Resources (HR) development to produce preferable results.

AI will be the future smart system with a strong impact on humans' lives. Since Stuart J. Russell and Peter Norvig published their first book "Artificial Intelligence: A Modern Approach" in 1995, the term has swiftly flourished worldwide acquiring the attention of major international businesses and educational institutions. However, with the rapid deployment of AI technologies, today AI has become a reality and it is used in engineering, automobiles, production management, healthcare, customer service, financial services etc., with an estimated investment in AI of 26 to 39 billion US Dollars in 2016 (Bughin et al., 2017). While Human Resources Information systems (HRIS) have significantly developed over the last two decades this intense focus on AI worldwide and competitive tendencies significantly affect HRM practices by redefining the methods in which organizations manage their human resources strategies striving to maintain and develop their HRM services, increase productivity, reduce cost and eliminate human errors and biases.

HR Recruitment and selection as an integral function of HRM have been impacted by the revolutionary technological advancement. The increased complexity of the new technological context and its association to the rapidly changing business environment have changed the conventional methods of employee selection by making it more technologically dependent (Everset al., 2005) when sourcing competent human resources. In recent years, the integration of AI solutions into the HR recruitment process has become increasingly common and growing day by day: automated smart systems are more and more frequently used in sourcing and refining; they even interact with job applicants to optimize and support the selection process. This paper aims to provide a comprehensive understanding of AI application in the HR recruitment process by addressing the following questions: To what extent will humans rely on AI to hire humans? How will AI affect recruiters' job? What are organizations and HR managers' roles in this transformation?

FUNDAMENTALS

Complications of Conventional Recruitment and Selection Methods

Human Resources are the main asset of nations and the first pillar for achieving prosperity. Within organizations, HR is a key factor for innovations, growth and competitive advantage; hence, organizations are in competition for acquiring qualified and highly skilled human resources. The importance of the recruitment and selection process stems from its pivotal role in determining the HR inputs in the organization (Sims, 2002; Cook, 1998). Owing to the expansive cost of poor recruitment or the failure to appoint an adequate person for the job, much attention is paid to the HR selection process to ensure its effectiveness. The goal of the recruitment and selection process is to provide the organization with necessary human resources at minimum cost with focus on core tasks and behavioural competencies needed to fulfill job requirements; yet, making a reasonably perfect selection decision is difficult to achieve.

The recruitment process consists of a set of interrelated tasks directed to shore up the overall organization strategy. It starts with planning future needs and analysing each vacant job to create their profiles. Once HR needs are clearly defined the following steps are sourcing, screening, selection and contracting, thus, the success of hiring decisions relies heavily on the effectiveness of planning and analysis process. HR recruitment has gone through many changes within its technical and conceptual level (Bartram, 2001; Anderson et al.,2001; Ployhart, 2006). Lievens et al.(2002) argued that owing to rapidly changing business environment with less defined and unstable jobs, conventional recruitments methods based on psychometric principles might no longer be effective. In addition, traditional sourcing methods such as job-applications and printed medium are shrinking in favour of internet sources and e-recruitment where the variation in the candidate's accessibility skills is significantly declining (Bartram, 2001;Lee, 2005). Researchers (Sims, 2002;Cook, 1998; Ployhart, 2006; Anderson, 2005) stated that globalization, changes in organization, technological advancement, laws, changes in society, social trends, applicant perceptions, fairness and diversity are all challenges and factors that influence and change recruitment and selection practices. Ployhart (2006) reviewed recruitment and selection studies from 2000 to 2006 and concluded that due to the changes in economy, society, technology and culture, organizations must realize that their success is heavily dependent on their hiring management though, decisions makers fail to recognize its value.

Furthermore, fairness and human biases are one of the major concerns for organizations throughout the design and implementation of the hiring system. Bias in recruitment occurs when an individual or group receives a favourable or disadvantageous treatment based on their characteristics such as age, colour, education background, ethnicity, religion etc. Bias is distinguished from discrimination by being an unconscious or unintentional human act, but it produces the same effect and results on human capital composition. Many studies (Davison & Burke, 2000; Ding & Stillman, 2005; Correll et al.,2007; Gordon & Arvey, 2004; Bertrand & Mullainathan, 2004) have been conducted on human biases that may affect hiring decisions; Davison and Burke (2000) reviewed 49 studies on gender bias and concluded that during the hiring process recruiters tended to bias against female candidates. Correll, et al., (2007) in their study about bias against ethnic groups held that white names candidates received 50 percent more call-backs for interviews than for African-American names. While human bias poses legal threats to organizations, it also hinders organizations' efforts to develop by limiting the quality of its human resources. To avoid this dilemma, companies' usage of screening software has increased significantly during the last decade where smart software provides organizations with an opportunity to avoid human bias throughout the candidates' scanning process.

Artificial Intelligence: The Reanimated Science

Artificial intelligence (AI) is not a new term; it can be traced back to the Second World War when Alan Turing published his paper "Computing Machinery and Intelligence", where he posed the question "Can machines think?", thus, the term "Artificial Intelligence" was suggested by John McCarthy (1958); Stuart & Peter(1995). Despite the major contributions of early scientists, AI was introduced as an industry only after the 1980s along with hardware development. The early utilization of AI manifested in the automation of complex, repetitive and precise job tasks such as industrial robotics production which replaced human jobs in several factories. After mid-1990s AI software witnessed a noticeable advancement such as "Deep Blue" smart software developed by IBM which defeated the World chess champion Gary Kasparov, text prediction on cell-phones and speech synthesis technology (Lucci & Kopec 2016). However, AI is reanimated science and we all agree that production robots or speech synthesis are no longer considered AI, contemporary AI consists of software and robots that simulate human intelligence.

Lucci & Kopec (2016) defined Artificial Intelligence as being able "to create computer software and/or hardware systems that exhibit thinking comparable to that of humans, to display characteristics usually associated with human intelligence". In other words, this intelligence is able to perceive, analyze and interact with its environment, learn from previous experience and solve complex problems autonomously without human intervention (Chui et al.,2015). However, the question which arises is, if these smart systems are supposed to mimic human intelligence, why do we need them to replace humans? After the vast advancement in big data, internet connectivity and computer hardware such as memory capacity and high-speed processors, intelligent software and robots are able to perform complex tasks beyond human capability (Lucci & Kopec, 2016). In addition to performing tasks instantly, smart systems and robots eliminate errors and bias risks which are associated with humans. There are various recognized disciplines and approaches in AI as follows: neural computation, data mining, genetic algorithms, expert systems, artificial neural network (ANN) (Kantardzic, 2011).

INTELLIGENT TECHNIQUES IN RECRUITMENT AND SELECTION

Several scholars studied and proposed models (Jantan et al., 2010; Masum et al., 2018; Strohmeier & Piazza, 2015; Tai & Hsu, 2006; Daramola et al., 2010; Ramar & Sivaram, 2010; Chien & Chen, 2008) that have incorporated intelligent decision support systems with recruitment functions, offering a set of solutions to improve the process efficiency and job matching. One of the mostly used AI techniques in recruitment is the Knowledge-based search engine (Strohmeier & Piazza, 2015) which is a system designed to search content within the web. Search engines recognize the meaning of the search content and perform a web-based search for fitting candidate's profile based on semantic annotation of job posting and profiles (Mochol, Jentzsch & Wache, 2007). Employers have to define key-words or a "reasoner" that describe the unique job characteristics such as job title, qualification, experience, etc. The knowledge-based search engine employs a predefined ontology-driven information extraction within the system to improve the search results for matching candidates (Çelik, 2016). For instance, "The recourse on a domain ontology allows the search engine to recognize that the vacant position sales director semantically corresponds with a searched position marketing manager among others" (Strohmeier & Piazza, 2015).

Expert systems are one of the earliest and simplest branches of AI techniques and have been widely used in business decision support and HRIS. Expert

systems are typically built in domains about human expertise with too many rules to be processed by humans (Lucci & Kopec, 2016). It produces comprehensive and effective results. However, expert systems recommend actions rather than generating opinions or learning. Several studies (Mehrabad & Brojeny, 2007; Daramola et al., 2010) have been conducted on integrating expert systems into the human resources recruitment and selection process.

Another AI technique which is commonly used in recruitment is Data Mining. Simoudis (1996) defines data mining as "extracting valid, previously unknown, comprehensible, and actionable information from large databases through an automatic or semi-automatic device and using it to make crucial business decisions". Data mining applications are not confined to excerpting information from an enormous database; they also provide an opportunity to analyse and predict potential significant implicit and previously unknown associations. Data mining has four functions: association, clustering, classification and prediction (Kantardzic, 2011). Chien & Chen (2008) proposed a framework for the data mining system based on decision tree technique which is often used for classification and prediction when screening an enormous amount of applicant resumes. The proposed system is used with demographics data such as age, gender, marital status, education, and experience to predict applicant's future performance and retention.

Strohmeier & Piazza (2015) argued that information extraction based on data mining appears to be an effective technique which could be used for Résumé data acquisition during the screening process. In addition, they suggested an intelligent text processing technique using text mining for sentiment analysis; the test automatically extracts sentiments and opinions within an unstructured text and classify them into "positive sentiments" and "negative sentiments". Such a technique could be used in assessing an applicant by analysing their sentiments within a textual context. Chien & Chen (2007) conducted an empirical study to test an intelligent system based on data mining in order to recruit and retain high-potential talents. Based on 29 rules, the proposed approach aimed to predict work behaviour such as performance and resignation to improve the personnel's selection process and recruit the right candidates for specific job functions. Petrovic-Lazarevic (2001), Dursun & Karsak (2010), Tai & Hsu (2006) presented a data mining systems based on fuzzy logic to support the decision making during applicant screening and selection process by minimizing the subjective judgment associated with traditional methods.

Among the AI techniques, contemporary AI-based decision support systems focus on Artificial Neural Network (ANN) which is considered much effective in reasoning and learning capabilities. ANN relies on machine learning and it aims to capture the parallel and distributed structure of the human nervous system as an attempt to simulate human learning capability (Lucci & Kopec, 2016). Huang et al. (2004) integrated the ANN technique into the human resources selection system by testing a model meant to evaluate managerial talent; they used neural network learning to determine the score of each candidate. Furthermore, Huang et al. (2006) used artificial neural networks to discover implicit knowledge and presented results that were useful in predicting employees' future performance and in supporting their allocation to suitable positions and projects. Table.1 shows a summary of some literature of AI applications in the recruitment and selection process.

CONTEMPORARY APPLICATION

Once the hiring decision is made, sourcing is the first step in the recruitment process. It is an essential task in which the selection of the sourcing methods is the key to the success of hiring decision. Several factors including demographics, cost and quality could influence sourcing strategies. Furthermore, the widespread use of the internet and online sourcing platforms eased the impressive access of candidates to the database (Parry & Tyson, 2009). On the other hand, owing to an increased labour shortage, e-sourcing increased the competitiveness among industries and commenced the so-called "the war for talent". Among other recruitment functions, sourcing is one of the first fields that widely incorporated AI within its process where several AI techniques are used to automate candidates' search and produce a better result compared to conventional sourcing methods. Nowadays, most online professional hiring platforms (e.g. indeed, Monster, Job-Builder) employs an intelligence search engine to match jobs with job seekers based on pre-defined job requirements. A high volume of AI solutions is available to streamline the sourcing process by conducting a wide instantaneous search for potential candidates for professional portfolios or social media. For instance, "Beamery", a candidate relationship management software, uses data mining algorithms to optimize candidates sourcing process (Dickson, 2017). It performs online screening across social media and hiring platforms for passive applicants, analyse their profile against the pre-defined job specifications and automatically notifies fitted applicants about the new opening.

Selecting potential fitted candidates from a large number of the applicants is a challenging task. The assessment of job applicants is the most time-

consuming part of the recruitment process. Human resources department may receive hundreds or thousands of applicants for each post. Conventional screening and short-listing that relies on human intervention to assess candidates' profiles is the most costly and frustrating process of recruitment. AI provides a promising solution to facilitate applicants' assessment process. The intelligent system learns the required knowledge, skills, qualification, experience and any other job attributes and then automatically reviews applicants' qualities and classifies them accordingly. The advantage of the AI system lies in its ability to homogenize and gauge the assessment process saving time and cost as well as neutralizing human mistakes and biases.

Chatbots are smart solutions that automate time-consuming tasks such as screening and assessment. Chatbots are AI software that uses neural language to interact with candidates through auditory or textual methods (Akash & Anusha, 2018). Once the candidates apply for the job and after assessing their application, the chatbot will initiate a real-time communication in the form of a screening interview; it performs various assessment tests and answers applicants' questions. According to studies, a majority of job applicants would have a negative impression if they did not receive any feedback from the employers. Therefore, the chatbot has significant potentials to improve the candidate's experience (Burgess, 2018) by providing consistent instantaneous updates throughout the application process which eliminates the communication gap between recruiters and applicants when dealing with a large pool of candidates. Examples of modern Chatbots that use machine learning in recruitment are Mya, HireVue and Wendy.

Mya is an intelligent recruitment assistant that provides an opportunity to automate 75% of the recruiting process (Dickson, 2017). Mya uses intelligent neural language to provide applicants with instant feedback and analyse their profile; it poses job- related contextual questions if needed, answer applicants' queries and continuously provides updates and feedback. In case of ambiguous questions, Mya's learning evolves throughout its communication with humans. Whenever the answer is not available, it will send the question to the recruiter and retain the answer for the future. In addition, Mya ranks applicants and provides a rating based on their qualification, level of engagement and their answers (Dickson, 2017).

The modern application of AI in the recruitment and selection process has found its way into face-to-face interviews with candidates. This involvement started with sensing and understanding human features by analysing facial expressions to extract emotions during the interview (Boz & Kose, 2018). Smart solutions such as Affectiva, HireIQ, HireVue that aims to assess a candidate's performance during a video interview are available in the market. They analyse candidates' face expressions, choice of words, tone of voices and speaking patterns in order to evaluate their emotional intelligence, honesty and personality. Recruiter uses these results to rank candidates and analyse whether they are suitable for the postion and organization culture.

WILL ROBOTS TAKE-OVER RECRUITMENT FUNCTION?

It is very much clear that AI plays an essential role in optimizing recruitment strategies. AI tools decrease the burden of weary and time-consuming repetitive tasks such as sourcing and screening applicants. Such leverage will contribute significantly to reducing the hiring cost and improving the quality of recruitment as well. In addition, AI will add more transparency to the hiring process, eliminate human biases and improve job seeker perceptions about the employers who will enhance employers' image and brand. For all those possible benefits, there is no doubt that artificial intelligence taking part in recruitment and selection will increase day-by-day.

Huang & Rust (2018) in their theory "Artificial Intelligence in Service" classify artificial intelligence into four classes: mechanical, analytical, intuitive and empathetic (figure 1). Although mechanical and analytical intelligences have widely replaced jobs at task level for a while, their importance is decreasing in favour of advance intuitive and empathetic intelligences. Furthermore, while Mechanical and analytical intelligences are more task oriented, intuitive and empathetic will rather intervene at the job level.

Intuitive and empathetic intelligences are advancing rapidly in recent years which pose a threat to replace a wide range of problem-solving managerial jobs. Self-driven cars or customer service Chatbots are examples of intuitive artificial intelligence, while Replika the online personal artificial intelligence friend is an example of empathetic intelligence application in real-world. Chui et al. (2015) expected that even highly-paid jobs such as financial managers, physicians, and senior executives are vulnerable to be replaced by AI in near future. Similar to other jobs, recruitment will not be safe in the automation era. We believe that the utilization of AI technologies in the HR recruitment and selection process will tend to increase at intuitive and empathetic levels. Table 2 provides an overview of potential AI applications in HR recruitment at all intelligence levels.

Intuitive solutions and Chatbots are used to interview and screen applicant's qualities, hence,

social, emotional, communicative, and highly interactive robots with picture and sound recognition technology will be used to conduct a face-to-face interview with candidates in the near future. Khosla et al. (2016) conducted an experiment using a social robot to interview applicants by assessing subtle variations in their facial expressions and sounds. The robot evaluated applicants' emotional and cognitive behavior based on verbal and non-verbal variables and benchmarked the results against the company emotional and cognitive profiles for existing employees in order to support selection decisions.

Will AI takeover? Probably AI will not fully replace a recruiter's job. It goes without saying that AI will be widely and increasingly used with better and more effective results. More innovative human-machine integration at the intuitive and empathetic intelligence level will evolve; however, the human touch will always be needed. This consistent reliance on AI technologies will dramatically affect talent acquisition jobs within HRM domains. Time-consuming administrative duties such as sourcing, screening and interviewing applicants will be handed-over to AI thus giving recruiters and HR manager more space to focus on strategic matters.

CONCLUSIONS

With the rapidly emerging trend of utilizing AI technologies in the business environment in the last two decades the HR recruitment and selection strategy of the HR mangement will gradually incorporate more AI solutions into its process. AI provides promising solutions for recruiters to optimize talent acquisition by taking over time-consuming repetitive tasks such as sourcing and screening applicants, to improve the quality of the hiring process, eliminate human bias and ameliorate job seekers' perceptions by improved communications. However, job-seekers' reactions may be influenced by cultural, social, legislative factors or HRM practice differences. AI application in HR recruitment will continue to emerge at a higher level of intelligence which will significantly affect recruitment and selection jobs as well as core competencies. Recent trends indicate that administrative routine jobs will be replaced by smart AI technologies and will gradually disappear enabling recruiters and HR managers to focus more on strategic functions. AI solutions will facilitate talents' access, which will increase competitiveness and place more pressure on organization and HR managers to adapt and incorporate AI into their recruitment strategies.

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APPENDICES

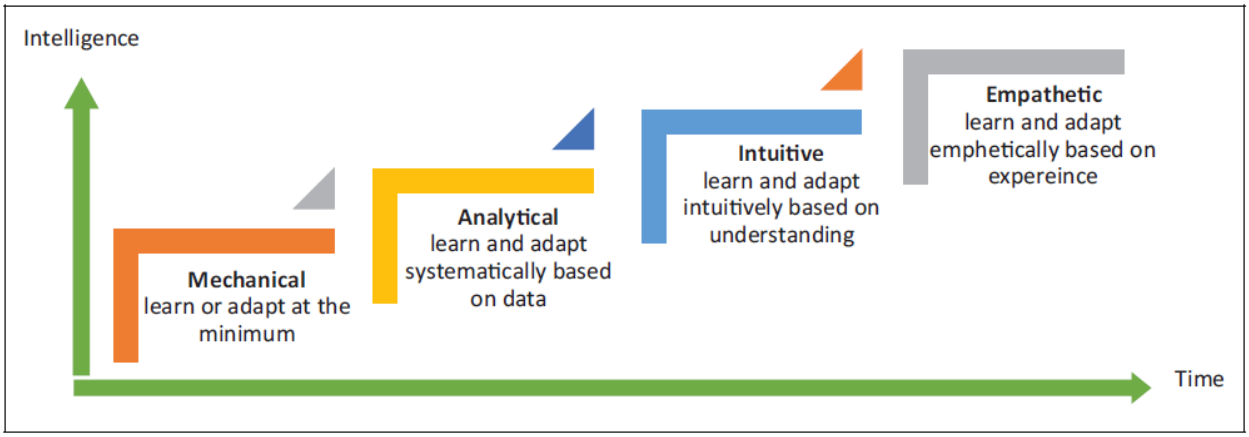

Figure 1
The Four Intelligences. Source (Huang & Rust, 2018).

Table. 1
Intelligent Techniques in Recruitment and selection

Application Area	**Problem Domain**	**Intelligent Techniques used**
Sourcing Human Resources	Match jobs with job seekers. Resumes information extraction.	Knowledge-based search engines (Strohmeier & Piazza, 2015;Mochol et al., 2007). Information Extraction (Çelik, 2016)
Screening and Short-listing	Assessment of job applicants. Classify applicants. Filter fitted candidates from a large volume of applicant pool.	Data Mining (Tai & Hsu, 2006; Chien & Chen, 2008; Strohmeier & Piazza, 2015). Fuzzy Logic (Dursun & Karsak, 2010; Petrovic-Lazarevic, 2001) Expert System (Daramola et al., 2010) and (Mehrabad & Brojeny, 2007).
Selection	Predict future performance. Discover implicit knowledge. Human resources allocation to proper positions and projects.	Data mining (Huang et al., 2006; Jantan et al., 2010) Rough Set Theory (Chien & Chen, 2007) Artificial Neural Networks (Huang et al., 2006; Huang et al., 2004)

Table. 2
Four Intelligences application in Human Resources Recruitment and Selection

Intelligences	**Example of possible application in HR recruitment**
Mechanical intelligence	Categorize candidates profiles and maintain updated talents pool Auto scripted responses for specific predefined candidates questions Check missing application requirement Schedule appointment an interviews Job advertising Keep records for correspondence with candidates Provide status updates and auto-responses for candidates Maintain talents database Automate contracting process
Analytical intelligence	Manpower planning and prediction Analyse HR skills gap Analyse Jobs Extract data from resumes Match jobs requirement with candidates specifications Predict turnover Rank and categorize candidates based on their merit Analyse and produce recruitment metrics (cost per hire, time per hire .etc.).
Intuitive intelligence	Understand jobs and generate an optimized job description Understand candidates queries and provide adequate answers Understand patterns and predict future performance Understand form metrics and provide optimal solutions Learn sourcing methods effectiveness and provide recommendations Evaluate candidate performance during a job interview and select the mostly fit ones
Empathetic intelligence	Recognize candidates emotions during a job interview Communicate with applicants empathetically based on experience Negotiate job offers with candidates Empathize with applicants while informing decisions Conduct job interview, understand candidates emotions and cognitive skills