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Artificial Intelligence tools, Recruiting process & Biases

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Abstract

This dissertation was written as part of the MSc in management at international Hellenic university. The purpose of this study is to investigate the role of AI technologies development in the field of recruitment and further investigate and analyze the potential biases and discriminatory cases which may occur using Artificial Intelligence tools throughout the recruitment process in general and in particular in Greece.

According to the literature findings the most cited disadvantage of using AI in recruitment are the potential biases resulting from unconscious human biases that are transferred into those algorithms as an input by the user. Therefore, the investigation takes place among both job applicants and human resource professionals in Greece, about their experience, attitudes and general beliefs towards the use of AI in recruitment and on what levels they feel this procedure can be overall objective, transparent and fair towards participants.

The authors of the present paper are Aggelos Koumoutsos and Georgios Bakas, and the supervisor of the paper is Dr. Vasileios Peristeras, with the assistance of PhD candidate Ioannis Ioannidis.

Keywords: Artificial Intelligence, Human Resources, Biases in recruitment, Artificial Intelligence in Greece, Recruitment automation

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Introduction

The business world has always been a competitive one and competitiveness has driven companies to the improvement of their tactics and the development of ideas. The top driver of change in the business field, which is, of course, technology and its applications on every business domain, has affected all operations of a today's business (1). According to the literature, Information Technology (IT), defined as "any equipment or interconnected system or subsystem of equipment that processes, transmits, receives, or interchanges data or information" by the National Initiative for Cybersecurity careers and studies (NICCS) (2), has been a great help to all levels of a company, from the people working in the production area to the top managerial positions.

Nowadays, that companies have shifted their priorities from tangible to intangible assets (bounced from 20% of firm value up to 80%, to finally settle in 65% of firm value), whose principal driver is human capital, it is more critical than ever for a business to get proper tools for "the war of talent" (3, 4). Good employees are hard to retain, because firms do not own people and people have always the choice of leaving, taking with them the knowledge and expertise and using it for the benefit of another employer. Black (2019) in a recent study of more than 5000 executives, revealed that more than 90% was thinking of? human capital as the most important asset of their firm. And so, companies are giving their best to find the best of the best, surpassing obstacles like distance, and focusing more on diversity? and inclusivity (21).

Through the last two decades, due to their effectiveness and efficiency, the World Wide Web tools, Web 2.0 tools, have been primarily used within the business sector. The Web 2.0 tools are no others than blogs, wikis, folksonomies, Really Simple Syndicator (RSS), podcasts and online social networks (6, 7, 8). The all-in-one platforms, such as Indeed, and the social media platforms, such as Facebook and LinkedIn, were the beginning of the digitalization of the recruiting process for both sides, the applicants, and the recruiters. As a result of the extended use of the Web 2.0 tools, the number of the applications increased, and the friction costs were lowered, but that also resulted to an increase of the unqualified applications, which in turn led to a need for more employees to evaluate the applications or to a tremendous delay of the recruiting process. Even though the Web 2.0 tools changed the traditional way of job applications, impacting HR professionals' and job seekers' lives, the e-HRM era did not manage to change the paradigm of recruiting. In a business world, that continuously changes and advances, that (Web 2.0 tools) was certainly not enough, and an effective recruiting process was crucial to be found.

As part of the 4th industrial revolution, Big Data, Cloud computing, Internet of Things (IoT), Artificial Intelligence (AI), Machine learning, and Deep learning are some of the greatest advances that followed. As Loukides (9) mentioned, Big Data is "when the size of the data itself becomes part of the problem and traditional techniques for working with data run out of steam". Along with the rise of cloud computing and the accessibility to more and more data, which became available to the companies, and to the public, the need for technology to analyze "Big data" successfully and effortlessly, became mission critical. To accomplish that, some of the biggest companies in the world, invested on the research for the AI and how they can apply it for their favor. AI became so important that on 2016, the "Partnership on AI, a non-profit partnership of academic, civil society, industry, and media organizations", was created. Apple, Amazon, Microsoft, and other colossal companies partnered together so they "can address the important topics rising at

the intersection of AI, people and society”, says E. Horvitz, technical fellow, and director of Microsoft research (10).

It is well documented that from the e-HRM era, we are now in the era of intelligent HRM (i-HRM), in which “any area of recruiting where distinct inputs and outputs occur — like screening, sourcing and assessments — will largely become automated”, as Katrina Kibben said (11). This is also the domain of interest of the present study, Human Resources Management (HRM). HRM is defined as “the process of acquiring, training, appraising and compensating employees, and of attending to their labor relations, health and safety, and fairness concerns” (5), and its combination with augmented or “smart” or intelligent technology, known as the i-HRM.

Artificial Intelligence in a few words, expressed by Kaplan and Haenlein (12) is a “technology system’s ability to correctly interpret external data, to learn from such data, and to use those learnings to achieve specific goals and tasks through flexible adaptation” and as it seems, today, it works in four forms: “Automated intelligence, which is the automation of manual/cognitive and routine/non-routine tasks · Assisted Intelligence, where AI helps people perform tasks faster and better · Augmented intelligence, which are AI systems that help people make better decisions · Autonomous intelligence, which are AI systems with automated decision making processes without human intervention” (13).

Day by day, AI tools are gaining more and more ground in the businesses and their practices become necessary. Many organizations are using AI and many more are expecting to do so within the next years in the HRM (14, 15). It is predicted that by the year 2030 “global Gross Domestic Product (GDP) will be up to 14% higher as a result of the accelerating development and take-up of AI” (13). Voice interaction, Visual scanning systems, Optical Character Recognition (OCR), Intelligent Robotic Systems (IRS) and Natural language processing (NLP) are some of the most innovative practices used for resumes screening, interviewing, matching suitable candidates with positions, etc. (16). AI recruiting tools have helped companies to simplify their methods, with many beneficial practices for the HR departments, and for the companies in general, on which we will elaborate more below.

However innovative, beneficial, and promising it is, AI comes also with limitations, challenges. The main ones, based on the literature, will be presented in this study, though our research will be focused on one of them, the biases that can occur when using AI tools. In the light of Amazon’s AI system case study, which was found to be biased against female applicants, as the profiles that the inventors of the tool used as samples for the tool were mostly men and, as a result, the AI system learned how to penalize women (17), we will investigate biases and their association with the AI-enabled recruiting tools.

In Greece, based on the Hellenic Federation of Enterprises (SEV) and its 2020 report (18), AI seems not to be a popular solution, as only 3% of the Greek enterprises are using AI in some way. Accenture’s survey agrees with that number, but other results of the report based on the beliefs of Greek business executives (20), which state that 85% of the Greek business executives believe that AI will create great new opportunities, 73% find that AI will change the competition as we know it, and 71% think that the adoption of AI will become a competitive advantage, seem to be very promising for the future of intelligent technology in Greece. In the Greek HRM, it seems that only 2% of the companies use AI.

For the evolutions of AI in the Greek enterprises, SEV has also proposed a detailed “National Strategy Action Plan for the Development of Artificial Intelligence” in Greece (18), Microsoft Hellas and ReGeneration are running the “ReGeneration Academy on Big Data & Artificial Intelligence” powered by Microsoft for the second consecutive year (22) and everything seems to be promising for the development of AI in Greece. Though the interest in AI and its applications is increased, especially in the post-Covid19 quarantine life, in Greece there is need for research. Deriving from the lack of research in the AI field in Greece and in combination with our interest in the HRM practices for the recruiting processes, this study will investigate the presence of the AI-enabled recruiting tools in Greece, focusing also on the biases around them, through three different ways.

More precisely, the main research topic of the present study will be the AI-enabled recruiting tools, the biases of the AI recruiting tools, and it will be investigated in three parts:

1. Literature review based on the AI recruiting tools, the benefits and disadvantages, with emphasis on the biases
2. Survey on Greek job candidates, on whether they find that the AI recruiting tools will be objective on selecting the most suitable candidates
3. Survey on recruitment specialists in the Greek market, on whether they think that the AI recruitment tools can be objective on selecting the most suitable candidates, or not.

The literature review, the methodology used in the research, the results of our research, the discussion and the future challenges/opportunities are presented below.

Literature Review (AI enabled recruiting tools, Benefits, Challenges, Biases)

The selection and recruitment process starts from the time that there is a need for human capital, within the company, to cover? and it continues even after the hire of the most suitable candidate, with the onboard engagement process of the employees. Through the last decades the processes that are part of the recruitment have changed radically, from the digitalization to the today's AI-enabled recruiting tools. The AI-enabled recruiting tools and applications will increase their productivity the HR specialists? the productivity of the HR...? (21). Gigantic companies such as IKEA, L'Oréal and Amazon, have realized the benefits of those tools and so they have deployed them (6). In fact, they are not the only ones, because based on the consulting firm's Mercer's Global Talent Trends 2019 report, more than 80% of the companies worldwide use AI in some way for various HR tasks (11). Below, we conducted a literature review, in which we present the different AI software that the AI-enabled recruiting tools are using and some of the most popular AI-enabled tools based on the stage of the recruiting process they are used, we describe the several advantageous and disadvantageous characteristics of the AI-enabled recruiting tools, and focusing on one of the most urgent issues to be addressed, the biases in the AI-enabled recruiting tools.

AI-enabled recruiting tools

Behind the scenes

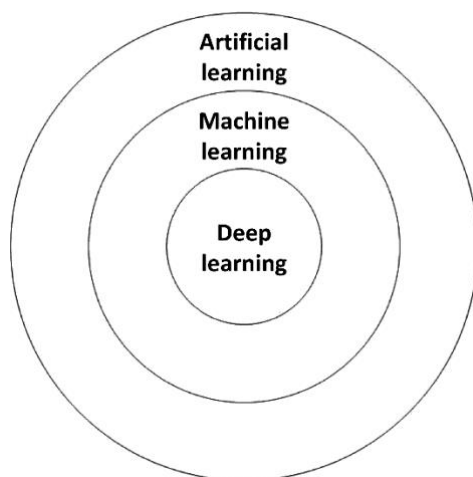
Plenty of definitions have been given for the AI and they all sum up to the fact that AI helps robots, machines, or programs to perform daily tasks that usually require human intelligence or to mimic the ways humans learn, interpret, and use their knowledge (Tecuci, 2012; Kaplan, 2016; (9)). Microsoft's first, and current, chief Scientific Officer, Eric Horvitz, defines AI as "the scientific study of the computational principles behind thought and intelligent behavior" and points out that the four main pillars of AI are Perception, Learning, Natural Language Processing (NLP) and Reasoning. (9) Kaplan & Haenlein (23) distinguish the applications of AI into 3 stages: Artificial Narrow Intelligence, which they characterize as weak and below human-Level AI; Artificial General Intelligence, equal to humans in several applications; and Artificial Super Intelligence, which is above the human level and outperforms them. In the HR domain, we are still in the first stage, as the AI-enabled HR tools do not autonomously perform the tasks and human guider is necessary, even though AI has managed to replace the HR professionals on some repetitive tasks, and it assists on various HR processes (12). Machine Learning and Deep Learning, subfields of the AI, are areas of big interest in the HR community, and we explain why.

Machine Learning is a subset of AI which is described as the intelligent system with the ability to adapt to changes in its environment and be able to learn from experience. As widely used as it is, ML can be found in call centers (*speech recognition*), social media (*face detection & potential suicide prediction*), online retail shopping (*product recommendation*), education (*personalized learning*) and the list goes on and on. The problems that ML can solve are categorized based on supervised/unsupervised and discrete/continuous:

- Classification problem is when the machine is expected to learn how to classify individuals from a given data set into discrete classes
- Clustering problem is when the machine categorizes individuals from a given data set using some kind of pattern from the data set
- Regression/prediction problem is when the machine is expected to predict an output based on historical data of individuals that are given to it
- Optimization problem is when the machine is improving the obtained model through evaluation and iteration.

Some types of Machine Learning Algorithms are Clustering, Decision Trees, Dimensionality Reduction, Kernel Approaches, Bayesian, Regression Analysis and Deep Learning (DL) (9).

As a subset of ML, DL uses Artificial Neural Networks (ANNs), which are computational models and algorithms that imitate the architecture of the biological neural networks, so as the machine to be able to label and assign every new information into various categories, in order to be able to understand it. The “deepest” the ANN of a machine is (i.e. the more layers it has), the more capable of performing more complex tasks the machine gets (10).



When talking about Natural Language Processing (NLP), we are basically talking about computers who are designed to understand human language, i.e., they are enabled to content categorization, topic discovery and modeling, contextual extraction, sentiment analysis, speech-to-text/text-to-speech conversion, machine translation and document summarization. A step ahead, Natural Language Understanding, a subfield of NLP, uses algorithms to resolve the complex obstacle of semantic interpretation of the language, that humans can comprehend (13).

Show time

Job advertisement postings are the tools that help HR professionals to locate useful context related to their ads and to improve their job postings content, based on company's values, job specifications and requirements, location criteria etc. Textio, using NLP and Text analytics, helps on the customization of the job ads and is used by top companies. For example, Johnson & Johnson and L'oreal used Textio to minimize gender biases

against women and achieved to increase diversity within their applicants and to attract numerous female candidates (1,2,14).

In 2016, RAI, by HiringSolved, was introduced, “the first artificial intelligence assistant for recruiting”, whose goal was to free up recruiters from sourcing candidates [9].

Candidate sourcing tools are used from recruiters mainly to reach out to different talent pools and to maximize the power of talent acquisition (17). To attract candidates from universities, Unilever used TheMuse and WayUp, increasing them from 840 to 2600 (1, 2). Other companies are using AI tools (Arya, Hireabby) to extract data from various social media platforms to match candidates with different jobs (2, 8). Hiretual, which is storing data based on relationships, is one of the most popular sourcing tools in the industry and companies such as eBay, IBM, and Intel (1) are using it to match with possible employees. The today’s AI sourcing tools are used to attract both active, and passive employees and can be integrated in the companies’ ATS (1, 2). There are many examples of such tools, as Nvidia matches candidates with jobs, based on user’s habits, information that extracts from their mobile phones (1), other tools are using predictive analytics and NLP to target candidates from various environments (Entelo, Beamery, Hiredscore) (5, 8).

Screening tools come after the pool of candidates has been created, mainly to minimize the time spent on the screening process (2, 5), by evaluating the job applications, performing behavioral/job-related tests and/or conducting the interviews. Plenty of tools will shortlist the resumes (17) based on the skills, roles and level of expertise (Pomato, CVVIZ, IDEAL), other tools subtract also information from social media, along with the resumes parsing, (Ceipal), some are based on their own profiles or on the database of the company’s ATS (Mosiactrack) and some are available in more than 18 languages (Textkernel). Apart from the resumes, companies need to assess other aspects as well, such as job-related skillset (Interview Mocha), specific knowledge based on the job (HackerRank, Kandio) or soft skills and culture fit (Harver,McQuaig), which can be achieved by AI assessment tools. On this stage of the procedure, the engagement with the candidates is a key factor for hiring the best candidate for the company, thus tools such as chatbots (2, 16, 17, 18) (Mya, Olivia) can be used to answer candidates’ questions, conduct full conversations, outreach them, schedule meetings at any time (5) and drop the time used in the screening process by 30-50% (6).

Video-based interviewing tools (18) also widely in use, as well, as they offer interview scheduling (X.AI) and real-time emotional analytics (Calendly), can filter out candidates and can be reviewed any time (PANNA), some available in 39 languages, also providing information about the company for the candidate to choose if they will apply (Talocity) and some even available to analyze personality traits and emotional expressions (4). A more unique case of video-based interview tool and very popular among companies is the HireVue (1, 2, 7, 19), a platform that uses AI to analyze facial expressions, voice tone and body language to compare them with ideal responses in order to conduct personality and behavioral assessments and suggest the best fits for the company. The colossal tourism chain, Hilton Hotels & Resorts (15) managed, amongst other benefits, to decrease the recruitment cycle from 42 to 5 days after utilizing HireVue for video-interviews.

Companies can also achieve to match with the right candidates, by exploring their skills, capabilities, and personalities through **game-based tests** (1, 2). Owiwi, a greek start-up,

is a very good example of gamification helping companies achieve their recruitment goals, such as the Greek firm Papastratos (20).

There are plenty of other software applications that HR specialists are using for various other tasks (9, 16), but they are not subject of the present research. Of course, further implications of technological tools, other than the AI tools, which are or will be able to assist the recruitment process' tasks, will be discussed on the "future challenges" part of the present research.

Benefits

There is a plethora of benefits occurring from the use of Artificial intelligence forms when properly applied in the recruitment process. From the extra useful time human resources professionals gain when time-consuming tasks are automated, to cost effectiveness and reducing unconscious human biases in recruitment and much more secondary benefits all occurring from the relevant literature.

Since there is a fast-growing tendency towards the adoption of such modern and useful technologies among companies and institutions, more and more human resources departments around the world are becoming dependent on it as well as attracting well-trained professionals in order to properly operate those systems for the best possible outcomes of their recruitment processes. The use of AI recruiters have the ability to automatically eliminate a big percentage of candidates, giving them the extra time to properly assess and evaluate the small fraction of the ones that are most eligible for the position, which is a very significant benefit for them (1).

As stated in a recent study most recruiters believe that AI should be mostly applied in initial screening stages of the process, since they believe that the human factor should be in place in later stages of the recruitment. Additionally, according to the same study, the use of AI in recruitment proves more efficient and effective in terms of speed and cost for both recruiters and applicants, plus the company's reputation in the relevant market (2).

According to Harvard Business Review, in terms of the advantages benefiting both parties simultaneously as well as the company's reputation, there are several extra benefits besides time and effectiveness. It is the fact that AI makes the process much easier by multiplying the first- and second-degree candidates through their existing employees, whenever they decide to advertise a job position opening. This is achieved by targeting their existing employees' direct network on social media platforms, such as Facebook and LinkedIn. When this is implemented, the number of relevant candidates is rapidly being multiplied by the number of first- and second-degree connections of existing employees, which is something that proves extremely efficient and effective for recruiters, since the procedure is unravelling fast while targeting mostly relevant to the position candidates. According to a survey by job site the majority of recruiters is already utilizing the social media recruiting tools for their professional needs. This has subsequently proved that the recruiting is automatically less biased and less clubby, by the time? because? the more effort is done online compared to the effort done offline, the bigger the probability to decrease biases that some recruiters cannot be aware of, such as the unconscious human biases. Lastly according to Harvard Business Review, the utilization of web analytics proves a very important tool towards the improvement of recruiters' efficiency. There is

an abundance of available data nowadays, and with data aggregation recruiters have access to a variety of useful datasets, which results to a faster easier and cheaper recruitment procedure (3).

Subsequently the aforementioned benefits eventually result in a productivity improvement which in some cases could even reach 800% Compared to traditional recruitment methods, especially when it refers to more complex roles, plus AI assist in avoiding toxic workers in the long term. It is also made clear that AI can never be biased in the same way as humans are who have motions, feelings and opinions that may be unconscious, but can yet affect the recruiters' final decisions (4).

One of the most significant, if not the most significant and most cited beneficial case of AI technologies human resources professionals in recruitment, is its ability to decrease, and even in some cases eliminate, unconscious or conscious human biases. It does not achieve this feature on its own in most cases, since its algorithm is always constructed by human software developers, or a combination of developers and human resource professionals who might transfer their unconscious biases into the algorithm. This is something that gradually starts to belong in the past since AI auditing tools and AI auditing companies start to apply their knowledge in attempts to improve the situation. Besides auditing there are also legislations, rules and standards when it comes to using AI in recruitment among companies, which makes it nearly impossible for those algorithms to operate, or based on its data, even lean towards operating in a biased or discriminatory way. The fact that a big amount of modern AI recruiting tools has flaws in the area of biases is very real. However, everything can be addressed since another major benefit of AI is the fact that it can easily be redesigned or reconstructed in order for it to operate within the required standards and meet specific beneficial specifications. There are already certain groups and organizations designing sets of principles in order to make AI in recruitment as fair, unbiased and ethical as possible. The key factor of their operation is that all AI recruitment technologies should be initially designed to be audited in all stages. Therefore, if it is appearing to be biased in any possible way in any given time in the future, or in case the auditing standards are not met, the defective technology will have the ability to be easily fixed (5).

During implementation phase of AI recruiting technologies, the algorithm has the ability to evaluate the entire pool of candidates, no matter the size, in a matter of seconds, compared to days, or even weeks in some cases, that the same procedure would take a human recruiter or a full department of them. This is something that makes humans rush through resumes in some cases since they are, by nature, time-constrained professionals. As long as, AI can go through the entire process in a matter of seconds, the tasks remaining to be taken care of by humans shrink to the minimum, hence there is no room left for inconsistencies, mistakes, and biases occurring accidentally if recruiters do not pay the required attention to the process. This is yet another way AI helps companies eliminate biases and increase fairness in recruitment (5).

An AI recruitment tool makes its assessment based on required skills and abilities according to the job posting predetermined standards, skipping factors that usually tend to be biased or lead to discriminatory decisions such as age, ethnicity, gender, nationality, appearance, etc. Most hiring tools nowadays have the ability to locate and recognize potentially biased language, whenever it is there as an input by the user, and in some cases operate as auditing mechanisms on themselves and achieve even identical results to the

auditing mechanisms. The AI can never be part of implementing unconscious human biases by itself, unless it is trained to do so, since the algorithm does not make decisions based on its opinion, feelings or emotions. Additionally with the use of machine learning companies can identify and eliminate skill gaps, which are results of employees quitting their positions on a regular basis. The use of machine learning has the ability to decrease and finally eliminate this high turnover rate among companies and organizations by generating an optimal employee skill profile, based on historical data of the skill sets that high performing, long term past or present employees have. This automatically saves large portions of the overall expenses of the companies since high turnover rates mean high training expenses for the constant ineligible newcomers (6).

When companies adopt and implement machine learning they gain the ability to estimate which candidate characteristics are better associated with optimal working performance, something which is entirely achieved by algorithms. Machine learning in the long term uses historical data in the before mentioned way to pick the ideal candidates faster, more effectively and more efficiently in the future, always compared to human intuition or other AI recruitment methods. It works both ways in most cases, benefiting both employers and candidates, such as the example off IBM, which provides the future applicants with the data generated through their talent acquisition processes, as well as their workforce generated data, in order for those wishing to apply for positions in IBM in the future becoming aware of the skills they need to develop or improve in order to increase their chances to be hired whenever they decide to apply for the position in the company (7).

AI empowered recruitment goes far beyond in terms of identifying and reaching out potential employees. For instance, NVIDIA has AI microchips for mobile devices with the ability to study the user's behaviour and patterns of their speech, which gives NVIDIA the ability to match job positions with available candidates (8).

One of the most frequently occurring benefits of AI in recruitment is the extra time professionals gain while using AI recruiting tools. As most professionals are looking to optimize their performance and recruit the best fitting candidates only, and given the importance of talent acquisition in general, the extra time gained from skipping the resume screening and resume sifting process, give them the luxury of evaluating what matters the most for their companies (9,10).

This is initially achieved through the adoption and implementation of AI resume screening tools, which utilize a wide range of AI capabilities towards the best possible talent acquisition results. During the next potential stages of recruitment, a process called robotic process automation is implemented by human resource departments. Robotic process automation results in the reduction of a lot of manual based work in order to achieve better results and faster growth by facilitating real time communication resulting in locating the right candidate with job matching initiatives (11). Furthermore, robotic process automation assesses the way candidates are applying for specific job positions, then automatically eliminates candidates with irrelevant skills, candidates with skill deficiencies and automatically communicates the reasons of rejection to them, providing more useful time to recruiters. Robotic process automation empowered systems eradicate unbiased systems, increasing privacy and securing sensitive data leading to better decisions during the recruitment process (12).

Another significant benefit for companies around the world when using an AI in recruitment is the objectivity and transparency, they are able to provide to candidates and existing employees. This automatically raises awareness amongst candidates in regards of the company's high levels of fairness. Additionally with every single candidate that applies for the job the AI is able to improve and adapt on its own to make recruitment even more efficient and effective in the future (13).

In Greece in particular companies are still in the orientation phase in terms of AI and its use in general and AI tools in recruitment in particular. Overall, just 3% of the companies make use of AI in Greece while the relevant worldwide average is 45%. Despite the low progress in this field companies in Greece are yet sceptical and refused to invest in adopting a AI in their daily operation. According to SEB's latest report it is stated that the latest relevant research has shown that companies in Greece that adopt AI techniques so profit margins of 17% higher compared to companies that don't (14). There are yet companies like Accenture that fully recognize the capabilities of using AI in their daily operation and work towards reinventing AI in order for it to fit in the Greek business standards, rather than following the global flow (15).

Challenges/Disadvantages

There are several challenges and limitations occurring from the use of AI among organizations worldwide. One of the general concerns that emerge and refer to all departments including the human resources departments is the ethical and societal framework each AI is being implemented in. Since AI is a powerful force that constantly develops, it is nothing but easy to regulate it and ensure its ethical use by companies. A software or algorithm which subsequently works towards maintaining and improving society in an ethical way should not devalue human skills, remove, or decrease human responsibility, reduce human control, or erode human self-determination. This is said to be one of the most challenging tasks to accomplish among AI regulators given the complexity and knowledge thus diversity in knowledge required (16).

Besides the ethical framework issues there are also issues occurring when it comes to individuals' human rights when using AI in the recruitment process. There are all human rights at work including non-discrimination, equality at the workplace, privacy and free expression and association. Hiring algorithms ending up being discriminatory tools that provide unequal access to employment is a result of the so-called Algorithmic accountability gap. This gap is created by the fact that AI principles are characterized as vague and not actionable which subsequently creates a lack of accountability in those mechanisms (17).

The most cited ethical concern in the relevant literature is the dehumanization problem. This regards to algorithms taking over human resources specialists' roles in the field of HR and talent acquisition which is something that largely concerns HR professionals and academics since as the term "human resources" indicates, the Human factor is not ethically correct to be reduced from this process (18).

Despite the fact that, in general, practicing AI in recruitment has proven extremely cost effective for companies around the world, this is not the case in Greece. By the time the country only consists of medium to small size companies and businesses, both in terms of available workforce and equity, just a fraction of them (3%) has the manpower and

financial capabilities of acquiring, processing and eventually utilizing AI empowered technologies for their recruitment purposes. The vast majority is not making use of AI recruiting tools for several reasons including hesitancy towards technologies such as machine learning and AI recruitment algorithms, inability to process and utilize those tools, and primarily the cost of acquisition of those tools. So eventually something that proves cost effective on an average global scale, ends up being the exact opposite for small Greek companies, unable to pay for, or utilize, AI recruiting tools (15).

According to multiple recent studies only a fraction (11%) of HR professionals possesses the know-how and required skillsets in regard to technology in order to implement something such as AI recruitment tools within their everyday working routines. Another survey conducted by Oracle on recruiters themselves, indicated that only 12% of respondents strongly agreed when questioned if they considered themselves knowledgeable enough about the topic of using AI in the talent acquisition process. This is a very crucial finding since HR departments required to use AI often find themselves in trouble processing all the information and data they acquire, henceforth in some cases they even reach out for help to the company's marketing departments. Those colleagues forge internal partnerships and help each other complete their needs, for example HR can collaborate with marketing for help on search engine optimization, a skill that will potentially improve HR professionals' efficiency and effectiveness in recruitment.

Since data and AI related skills are a rare phenomenon among HR professionals, those who do possess this digital savviness are eventually the ones who climb the corporate ladders faster, approximately six times faster than others in particular (10, 19, 9, 20,).

Finally, according to the relevant literature, some companies' HR departments are running the risk of being completely taken over by the extended use of AI recruiting tools within their organizations. This is listed as risk by the time all available data and most HR professionals strongly disagree with the idea of AI possibly overtaking the job of a human professional. As the term "human resources" itself indicates, this is where the human capital of an organization is assessed and evaluated at all potential stages of their working life cycle, therefore the human element cannot be excluded or widely deducted from this equation. AI will never be able to measure and evaluate values that a well trained and experienced human professional can, values such as desire to improve and collaborate, emotional intelligence, intuitiveness, empathy, and emotional understanding and even tendencies towards teamwork. AI will always be developed and trained to make decisions based on the given data and completely ignore the above-mentioned human factors and values, something that is a major drawback when more and more of technology is taking over HR departments, making it an absolute need to better train professionals in properly using this kind of technology, while keeping their positions intact in the organizations (10, 19).

AI mistake cases in hiring are spotted in major companies and corporations, biased cases or behaviour in recruitment can be found anywhere and at any given time. This is primarily due to the fact that yet to date the majority of the AI and data related workforce consists of male professionals, and since this trend was stronger in the past, those lasting AI recruitment tools are highly likely to carry on the exact same biases and mistakes with which they were built and initiated. Modern IT departments are required to carry out extensive checks and controls of the data sets they possess for their recruitment algorithms to ensure the data set has the diversity required to eliminate potential biases. Newly

acquired tools with fixed data sets in their algorithm might claim that they have the ability to analyse the facial expressions and body movements of candidates, or even their voice tone to measure, analyse and evaluate the candidate's personality and working performance. Those are attempts to measure how culturally normal a person is, but there is always the risk of excluding candidates with some form of disability, appearance deformity and other potential unique characteristics, resulting in the company's recruitment algorithm becoming a discriminating automated tool. Ultimately AI companies can claim that their recruitment software has unlimited and diverse capabilities, but it is each company's responsibility to use unbiased and legitimate software while they recruit employees (10, 21, 22).

As mentioned earlier, most of the workforce in data science and AI positions are men. According to the world economic forum only 26% of worldwide data science and AI roles are occupied by women. According to the same source this is due to the belief that women are not as good as men are at math, from early high school ages which perpetually is a bias itself. This belief represents at Keats half of 15-year-old girls who answer that they are not good enough as men at math and tech related tasks. Women also in existing data science and AI roles tend to have a much higher turnover and attrition rate compared to men. This evidence provides significant reason to suspect, at the least, that recruitment tools created by the male workforce of the relevant departments is likely to be biased against women since it's early creation. All biases and discrimination related issues occurring in AI recruitment have extensive literature and events on its own, therefore it is made necessary to dedicate an extra section on it for a better in-depth analysis of the subject (24).

Sadly, even while top members of corporations recognize how critical and important is the implementation of the digital tools such as AI recruitment tools their real implementation practices tell a different story. A survey conducted by Deloitte discovered that 72% of the top companies' executives believe AI in talent acquisition is crucial, though just 31% of them believe that their companies were in position to properly utilize the tool's capabilities (8).

Despite the wide capitalization on the functionality of AI in recruitment, very little is known for the opinion and awareness of it by potential candidates. Applicants on several occasions tend to be anxious towards some forms of AI recruiting methods, and sometimes eventually decide to not even apply or progress with their applications when they suspect that AI will be used. Some companies decide to implement initiatives to hide the fact they use AI in recruitment, while other companies and organizations invest in reducing anxiety levels of potential job candidates in order to persuade them to apply. This is something which is counterproductive for both parties, since applicants should concentrate on improving their chances on being hired and companies should concentrate and invest in recruiting the best fitting talent in the most efficient and effective way instead of hiding their recruitment techniques (25).

Bias and Discriminatory Circumstances

"Discrimination is treating differently without an objective and reasonable justification, persons in analogous, or relevantly similar situations" (8). It is well documented in the literature, that humans use different kinds of biases (such as homophily* (3)), which can lead to discrimination and exclusion of some groups or people, related to race, income

status, sexual orientation/gender identity, religion, gender, and other characteristics (8, 14, 18). Bias can work in different contexts (and sometimes they can be caused by the context (21)), for example in the context of an interview, the interviewer might be, consciously or not, guided by Halo/Horns effect (18, 23), when one is misjudging, positively or negatively, all the characteristics of the interviewee based on a single (positive or negative) characteristic · Snap judgements/First impression (18), when one takes a decision for the interviewee within the first minutes and for the rest time is looking for confirming evidence · Stereotyping (6, 18), when one tends to misjudge the interviewee based on their connection with people of specific groups with certain (positive or negative) characteristics · Similarity/Dissimilarity bias (18, 23), when one is misjudging the interviewee because they appear to have similar or not similar characteristics with their own · Rater Bias (18), when one, based on personal bias, is misinterpreting the value of an interviewee · Insider/Outsider bias, when an internal employee is selected over an external candidate due to bias and not suitability for the position (23) · Contrast bias (18, 22, 23), when applicants are values in relation to another applicant's value and not the performance of the interviewee.

As everything turns digital nowadays, the digitalization of discrimination is evident as well, even though unexpected (4), with numerous examples, such as the Apple credit card (8) manifested female-discriminative results, several facial recognition software (11) against darker-skinned people · Twitter (13) misgendering higher percentages of gay men and straight women (32% & 16% respectively), than straight men (8%) · Tay, Twitter's Chabot, which was taught being racist from random tweets (3) · medical care examples racism against black consumers (14) · examples from daily life, with Uber & Lyft (11) to be found with higher waiting times and cancellation rates for customers with African-American names · higher pricing in areas with predominantly African-American population · Facebook's ad serving algorithm (11) choosing the ad exhibits based on gender, race and religion.

Despite the amount of attention given to the importance of the inclusion and diversity in the workplace, discrimination in the workplace still exists, only that nowadays, "has become invisible, deep and pervasive" (15), due to the implicit, cognitive bias (26). Humans are not aware of carrying those biases, as they are part of their unconscious (3, 16), but in their name they might keep on excluding people from the selection process, and not based on the candidates' expected future performance on tasks related to the job (17). Due to the digitalization of the recruiting process and the new technological tools that HR specialists use, as described earlier, below we will focus on the literature around the biases that AI recruiting tools bear, who can put "certain groups or people at a systematic disadvantage" (7, 14).

At first, as it is widely mentioned in the literature, the most common bias found is the algorithmic bias, which is defined as "a discriminatory case of algorithmic outcomes that may have an adversarial impact on protected or unprotected groups due to inaccurate modeling that misses associations between output variables and input features, suggesting that they can result from underlying dataset, inadequate methodological approaches or embedded societal factors" (14).

Srinivasan & Chander (11) summarize the different biases that can occur throughout the different levels of the AI use, from the construction of the AI tool to the analysis of the data that will be provided. Divided into three categories, they present:

1. biases related to building datasets:

- sampling bias, when the sample selected for the dataset is not representative of the real population,
- measurement bias, when human errors affect the collection of the data, leading to poor quality data or not valid data
- label bias, when different labels are assigned to the same object or emotion etc., either because of different preferences of the annotators, or personal and/or other biases of the evaluators,
- negative set bias, when the negative instances of a phenomenon underperformed, as a result of focusing on the positive instances,

2. biases related when formulating the problem:

- framing effects bias, which refer to biases rising from the problem formulation and the information presentation,

3. biases related to the algorithmic/data analysis:

- sample selection bias, when the samples selected to be finally analyzed are not representing the population,
- confounding bias, when there are relations in the data that are irrelevant or not all the relations are taken into consideration,
- design related bias, which occur due to restrictions of the algorithm or the system,

4. biases related to the evaluation/validation process:

- human evaluation biases, when biases coming from the people who are employed to evaluate the performance of an AI tool
- sample treatment bias, when the biases arise from biased test sets
- validation & test dataset biases, which are biases related to the dataset-creation stage that can occur during the evaluation/validation process.

The biases that are related with the evaluation from humans is also referred to as feedback loop, suggesting that as long as the human interacts with the algorithmic system, the system will be adopting the human's biases, even they are removed in another stage of the procedure, creating a vicious cycle (8, 14).

Similarly, Yarger et al. (25) refer to data set bias, when the data sets are not representative· association bias, when the data sets for the training of the algorithm are reinforcing or increasing the existing biases· automation bias, when automation surpasses cultural does not consider sociocultural differentiations· interaction bias, when biased result arise because of the interaction of the machine with a human· confirmation bias, when a single person or a whole group of people are discriminated due to “overly simplified personalization”.

Xavier et. al (7) are distinguishing bias into three different groups, Bias in modeling, Bias in training and Bias in Usage based solely on the algorithmic biases. They point out the importance of differentiating discrimination from biases, and vice versa, and the need to focus on resolutions, as the decrease of bias leads to an increase of numerous advantages, such as increase of trust (19) and increased applicant engagement (4).

In the field of AI in the recruiting tools specifically, as described (14) the algorithmic bias can originate from the training datasets (which can be inadequate/underrepresented, of insufficient size, using homogeneity or assimilation bias (22)), the methodological approaches (confusion between correlation and causality, overgeneralization of the findings, confirmation bias (11)) and socio-cultural sources (inclusion of historical and/or social discrimination). Furthermore, findings (13) are pointing out that AI tools might “boost”, rather than decreasing, discrimination and bias, and are focusing on the existence of representation bias, labeling bias, discursive fairness bias, historical bias, and stereotypes (25).

Others (8) focusing on the main population groups the digital discrimination is constantly affecting, such as gender discrimination, sexual orientation/gender identity discrimination, and race discrimination, based on examples from gigantic companies, as briefly described below.

From the late ‘90s example (11) of a British medical school, whose shortlisting algorithm was discriminating against female candidates and candidates with non-European names to the well-known example for gender-discriminating AI tool, Amazon’s case, which was found to screen out female candidates. Only if someone would think, that in companies, who are data and innovation leaders, such Facebook or Google (8) for every 5 men working in the company, only 1 woman is working for them, one would understand the underrepresentation of feminine figures. In fact, Facebook’s ads (14) for jobs related to science, mathematics, technology, and engineering was found to be focusing on males.

Research has also shown that AI industry is “ruled” by young adult white men (4), for example the human capital of Microsoft and Facebook contains about 4% of Black workers, and Google’s only 2.5%, numbers that have rose by 1% the last decade, or they have not rose at all (8). In the context of the AI industry, Timnit Gebru (27) points out the dominance of white males both in the data sets and the professionals. Thus, as the workforce of some of the biggest IT companies and the data sets, are not racially diverse, it is expected that the algorithms running in the AI tools will not be trained as diverse too. Same applies to other subgroups of the population such as people with disabilities (24) and people of the LGBTQ+ community (8), who are also underrepresented.

To do so, there are different approaches of eliminating bias, either by focusing on the algorithm itself, or by focusing on other factors, like the context in which the algorithm is used.

How to fight bias/discrimination in the AI era?

Combining diversity and inclusion is always a good path to follow for unbiased results, and so Mathis & Jackson (2010), are explaining, in their book, the idea of “Build acceptance of Diversity” and “Solve Diversity issues and create an inclusive culture” trainings can work in favor of all sides for annihilating human biases (18).

Focusing on the AI practitioners, the ones responsible for the development of the algorithms, it can help on mitigating bias (11). Acquiring domain-specific knowledge, understanding the application-related and important qualities, using population-represented data, standardizing data interpretation, identification of all the target-related

features, avoidance of features associated with both the input & the output, carefully choosing subsets of dataset when analyzing data or testing a model are some suggestions.

Gummadi (12) in a discussion about the ways of training an algorithm to non-discriminatory decision-making, points out the difficulty of building fair algorithms, minimizing their series of errors, for entire populations, because of the different subgroups of the population. Such difficulty refers to translating the human meanings of fairness, accountability, and transparency, so as to use them computationally, finding the solution in abandoning the existent way of thinking of fairness, finding a more adaptable, to the algorithms, definition.

As Gummadi refers to the more theoretical process of actually quitting biases before developing the algorithms, when on the other side, research also focuses on the practical/technical implications for creating unbiased, or fixing the biased, algorithms. Xavier et al. (7) suggest that key factor for creating bias-free digital tools is to have bias-free algorithms, taking into consideration social, legal and ethical perspectives. It is stated (7, 11) that access to the information used for the creation of the algorithms, is limited, and so it suggested to test algorithms for biases during the process of algorithmic formulation, data creation and data analysis.

More specifically data security limits the access to the datasets used for training the algorithms, so those datasets cannot be examined for biases. Also, the algorithm's source code might not be available publicly, limiting the possibility to eliminate modeling biases. The way an algorithm will be used, and the context should never be ignored as well. Thus, as we depend on what is available, maybe a new authority should be formed, or as part of the GDPR, in an effort to test the datasets and the models used for the algorithms for biases. Finally, evidence shows that the algorithms can be manipulated in the interest of a company, whose intentions are not always obvious or ethical (4).

In the context where there is access to the datasets, there are two categories of identifying and fixing biases in an algorithm (7). The first one refers in the process during the construction of the algorithm (procedural), on the logic behind the algorithm, (using decision trees, association rules, causal reasoning, counterfactual explanations). Although procedural measurements will help in the creation of non-discriminatory algorithms, they will not guarantee that the algorithm will stay unbiased during the training or while in use. Thereby, relational measurements will assist in the creation of unbiased datasets and/or unbiased algorithmic outputs and will not require insights into the algorithmic process.

Cross disciplinary checks, with collaborative works of legal (using the antidiscrimination laws that focus between protected attributes and decision outcomes, finding laws that can handle the complexity arising from algorithmic discrimination), social (differing attitudes towards computation and literacy, obfuscate the distinction between bias and discrimination) and ethical approaches (by reassessing the existing moral standards) should be considered. The metrics from the bias measurements can be statistical, similarity-based or causal reasoning.

Emerging from the urgency to find the best talent, or the fear of rejecting one due to biased algorithms, and based on the previous theoretical background, several companies have designed tools for bias detection and prevention within the algorithms. FairTest,

which detects bias in the data sets, IBM AI Fairness 360 toolkit, which detects and mitigates bias in ML models, Google's Whatif-tool, investigates how different models perform in the data set and strategies for upgrading.

Since there is a fine line from a biased algorithm to an inaccurate algorithm, the work around the biases within the AI algorithms must be thorough. Especially with methods that interfere, the removal of specific data qualities, which might not even result in effective removal of biases (proxy attributes), includes a fear for losing accuracy, and it may change the perception of the world that the AI algorithms makes use of, instead of only the required change in the perception of the biases.

General Study Methodology

For guiding our path into constructing our study's research methodology, we consulted *Research Methods for Business Students Eighth Edition* by Saunders et al. (1).

Our study is a cross sectional multiple methods study. It is cross sectional, because we are studying the biases of the AI recruiting tools in the present time, and multiple method study, because to answer our research questions, we need to use different research methods and collect both, qualitative and quantitative, data. Our research purpose combines two types of research, exploratory research, and descriptive research. The exploratory research is based on the extended literature review on the AI enabled recruiting tools, their benefits, their challenges, and the biases that can occur when using them and, on the interviews, we conducted with Greek HR professionals, to gain insights on their perceptions for the AI enabled recruiting tools and the biases in the HR recruiting process when using AI-enabled tools. The descriptive research is based on the picture, we are drawing, of how Greek job applicants experiencing the use of AI-enabled recruiting tools and their perception of how those tools can be objective during the candidate selection process or not.

We did put all our efforts to ensure that our research design would not subject the participants to any risk of embarrassment, pain, harm, or any other material disadvantage and requested their consent using a consent form. All the participants were informed that they can leave or stop the process at any time they feel that they would not be comfortable to continue. Also, we reassured them for the anonymity of their participation and the security of their personal information.

For the validity/credibility/authenticity of our study's results, we used the triangulation technique, as more than one source of data and method of collection were used. Using interviews, questionnaires, and literature review, we used mixed methods study to find out how biases affect the AI-recruiting process and the parts involved in it.

Questionnaire's methodology

For the purposes of the present paper as part of its research methodology it is necessary to make use of an internet-based questionnaire for the best possible understanding of the Greek perception of artificial intelligence recruitment tools and their use. The main objective is to receive sufficient data on whether it is a general belief that those tools might be biased and on what level they are going to be objective during any recruitment process. The questionnaire is internet based and self-completed, therefore completed by the respondents. The tool used to construct, implement, and deliver the questionnaire is Google forms.

Questionnaire's Mode & Data Requirements

The present questionnaire refers to the Greek population including people who have had experience with AI recruiting tools. That would be any form of AI screening tool, automated video interviews, AI applicant rating software and more. There is not a specific ideal respondent since the investigation is meant to collect data on the general perception on whether or not the use of such tools during recruitment is perceived as

biased, and on what level that is or not, referring specifically to the Greek population the main target group. It is of significant importance that respondents express their true perception of the use of those tools, in order for the data to be representative of the wider population and accurate. For this reason, it is necessary to make use of paraphrasing some of the survey questions for achieving the best possible data accuracy.

The estimated sample size in order to receive the necessary amount of data required is 150 to 200 responses. With that number of responses given by the target group the sample will be accurate and with a minimum deviation from the population perception of AI recruiting tools, since the target group itself is a very specific one in terms of size, plus the investigation will be combined with interviewing Greek HR specialists in order to have greater accuracy. The number of questions to be answered is 30, with some of them clearly being paraphrasing questions for reasons of data accuracy. Those are the standard demographic multiple-choice questions and the main body consisting of rating questions in order to receive a wide range of perceptions and opinions of the Greek job market referring to the use of AI recruiting tools on whether they're biased or not. The type of questions asked in the main body are exclusively in a rating form, expressing the level of agreement of the participants, with the demographic questions as the only exception. The level of agreement in the survey questions are split into five categories ranging from strong disagreement to strong agreement with each individual statement.

The observations to be taken into consideration are the participants' demographic characteristics, in order to investigate whether the use of AI tools is concentrated only in Greek urban areas and which age groups are most likely to come across some of those tools while applying for job positions. The main body variables aim to collect data on Greeks' attitudes, opinions and behaviors in regards of the use of AI recruitment tools, and there is an intellectual comparison with the traditional in person recruitment process for both reasons of accuracy and reasons of investigating the attitudes of applicants against both recruitment methods. The data collected will provide a comprehensive understanding of what the Greek job applicants feel about being assessed by AI and on what level they believe this technology can be biased either against them or in their favor.

Questions of general opinions and attitudes are concentrated in the beginning and more specific and personal or more sensitive questions are maintained in the end of the questionnaire for reasons of data accuracy during the questionnaire completion. They are formed in a way so no participant will be in any way uncomfortable, anxious or stressed about answering the questions and participating in the present study. The relevant data requirements table can be found in the appendices section. (Appendix 1)

Question's methodology

Questions are formed and placed in order of magnitude and detail, in order to create a linear impression and be as accurate and as well as very pleasant to answer. The data collection therefore is done on the appropriate level required by this investigation. Responders will not need to have any specific or advanced knowledge to answer any of the questions, other than reading the instructions on the introduction section. The entire questionnaire follows simple wording in order to avoid jargon, abbreviations or

colloquialisms. There are words and phrases that sound similar to one another, also compared to other questions, although this is due to the best possible data accuracy. Additionally, all questions are formed in a way so that no more than 1 question occurs within each question through wording, so the data received is perfectly precise and accurate. Instructions are clear and simple, especially since the survey is primarily demographic and rating investigative questions, researching perceptions.

All questions occur through the relevant literature reviewed for the purposes of this paper and concentrate around the perception of the use of AI recruiting tools in practice for the Greek population. Therefore, all the questions occurred are accurately translated and delivered in Greek language. The answers delivered are expected to provide sufficient data on the perception of responders in regards of the level they feel AI is on any level biased and taking over recruitment process, on what level this fact is affecting the productivity and efficiency of the recruitment process, how they feel on a personal level about being assessed by any form of AI tool, whether they feel that an AI tool will properly assess their skills and be fair against them, their perception on whether AI recruitment tools are biased or not and their preference of assessment comparing AI recruitment tools against recruitment with human intuition and real time man to man interaction and assessment.

Furthermore, a pilot testing session will take place before delivering the questionnaire to the target group responders. It will be delivered to 10-15 individuals of the population, in order to assess approximate time needed to complete the questionnaire, to collect feedback on the accuracy and on the order of the questions, eliminate any potential bias in the questions' format and order and double check the data accuracy occurring at that stage. The questionnaire can be found at the appendices section at appendix (2).

Interview's methodology

To examine our second research question, the perceptions of Greek HR specialists, who are currently working in the Greek market, about the AI-enabled recruiting tools and the biases, we used the semi-structured interview as our tool. The reason behind this decision is that we wanted to gather valid and reliable data, from people who are witnessing the recruiting process in their everyday routine. To do so, we needed a non-standardized and consistent form of interview, where we would use some predesigned questions, related to the topic, to guide the conversation, and, if needed, to be able to request further explanation from the interviewee by using probing questions. Every interview was video-recorded, due to the purposes of this research, with the consent of the participant. Due to the Covid-19 situation and current measures, we found that it would be best if the interviews were all held online, through zoom call. In every zoom call the participant would speak with only one of the researchers, as we thought that the rapport would be built easily in one-to-one interviews. Also, since the interviews were video recorded, there was no need for the presence of another person taking detailed notes, thus avoiding someone's silent presence, which could affect the interviewees, and as a result their answers. Thus, the researcher, who was conducting the interview, was also able to be keeping notes for the interviewee, the location, and whatever other information would be useful for the needs of the present study. Finally, the interviews were held in the Greek Language as we wanted to avoid any language barriers. Also, we found that discussing about the Greek market, with both the interviewers and the interviewees being Greek, in another language could limit the participation of the interviewees in the conversation, due to unfamiliarity with a foreign language. Below we discuss the different data quality

issues we faced during the preparation of the interviews and how we addressed those issues, to maximize the quality of the present study.

At first, biases in different forms, such as interviewer biases, interviewee/response biases and participation biases, are possible to appear in interview-based research. To eliminate them, we, as the interviewers, we had to be well prepared ahead of the interview and to be careful while conducting the interviews.

Thus, to be well prepared before the interviews we gained knowledge in the topic by completing the literature review· carefully designed the questions of the interview based on the literature, using open questions in appropriate and comprehensible language, along with appropriately worded probing questions· prepared and sent to each interviewee a list of the themes to be discussed during the interview· informed each interviewee ahead of the interview that if there is any organizational document, that they would think as useful for the purposes of this study, they are free to share it with us and it would be treated as highly confidential· due to the pandemic Covid-19 situation still affecting our lives, the interviews were conducted through an online platform, Zoom in this case (account provided by the International Hellenic University), and it was requested from the participants, if possible, to be in a room/place that they feel comfortable, with a good connection to the internet (possibly an Ethernet connection) and where they would ideally not be interrupted by family members or colleagues.

During the interview, as the interviewees were HR specialists, we also choose business appropriate clothes· explained the research purpose again· gained verbal consent, too, for each interview· made sure that they had no questions before the interview started and answered any question they had· kept our voice tone neutral, without commenting or making facial expressions.

By carefully preparing and conducting the interviews, as described above, we also managed to minimize the effects of possible validity/credibility issues*. In regards of the interviews, reliability is not in priority, since the research method was chosen to investigate the topic in the present time and since the circumstances are rapidly changing in the field of AI, and so the repetition of the present study it is not an immediate intension of ours. However, the preparation of the present study ensures the minimization of possible reliability threats. Although, the research design, the reasons behind the decision of using the specific research method, the collection and analysis of data are well explained, to ensure the dependability of our study.

Specifically for the results from this scenario, the results cannot be statistically generalized about all the Greek HR professionals, as the data come from a small non-probability sample, and in fact the importance of this study is to explore, explain and provide insights for the ways the HR professionals experience the AI enabled recruiting tools and the possible biases in their working routines. On the other hand, to increase the generalizability* of the results, we interviewed HR professionals from different organizations/companies and our results are connected to the existing theoretical background. Also, a thorough description of how the interviews were conducted and the interview questions are provided in the present study, so someone else could similarly reproduce it (transferability*).

Finally, there were no significant culture differences, as the interviews and the interviewers are Greek professionals, living and working in Greece.

Results

Questionnaires' Sample characteristics

After the distribution of the questionnaire 180 answers were received from participants. The majority of the sample representing 67% of the total were women residents of larger cities and have high educational backgrounds, with 66% of them holding a master's degree and an additional 30% holding an undergraduate degree. More than half representing 50% of the total are private company employees in Greece and 67% belong to the lowest income category of €0 to €10.000.

Questionnaires' results

The vast majority of the sample has participated in a recruitment process at least once during their lifetime while searching for job positions, although just below half of them (41%) have participated in a recruitment process which made use of some form of AI at some point of the process to screen, evaluate and assess applicants. It is also worth pointing out that just a fraction of the sample (5,5%) declared uncertain of whether they have been assessed by AI recruitment tools or not, a relatively low number when taking into consideration the fact that a large portion of AI is used in recruitment exists in social media, which according to the literature goes undetected by attendees in some cases.

Respondents answered that they feel mostly neutral when asked about their interest levels towards being assessed by AI when applying for a job position, while they also tend to feel neutral towards positive on whether they feel AI in recruitment is objective or not. Despite the above, there is a relatively strong preference towards being assessed by human recruiters instead of AI empowered technologies when applying for job positions, although there is also a tendency towards the use of combinations of both techniques, since 67% of participants replied positively when questioned about the combination of human and AI recruitment procedure.

In particular, it is made very clear by the answers that they would rather have their initial resume screening done by algorithm and the rest of the secondary stages of the recruitment being completed by human recruiters. Since the in-depth AI talent acquisition is not something very popular and clear in Greece, participants declare a tendency to trust it only in very basic and very initial stages of the recruitment, while they are mostly neutral towards the objectivity of the two methods, with 70% of them leaning towards the belief that AI recruitment tools are predominantly created for better objectivity and less bias in the talent acquisition process.

Furthermore, in terms of objectivity and transparency in recruitment, most respondents have answered that they find the assessment criteria of AI recruiting tools more objective compared to human professionals. Additionally, the majority of the participants expressed high levels of insecurity towards AI compared to HR professionals and at least 65% of them said they would feel more comfortable when being assessed by human recruiters compared to AI recruiting tools, something that perfectly reflects the responses in the earlier levels of trust towards AI section. Also, the levels of caution between AI and human are significantly higher towards AI, something that once again reflects the relevant

literature pointing out that AI in recruitment in Greece is yet something mostly unheard of.

When asked about their belief on whether their skills can be easily detected and assessed by AI, the participants replied that humans can detect some of their skills in a more efficient way compared to some AI algorithms. This is due to the fact that most participants believe that some of their resume declared skills or working, and job abilities are too complex to be properly recognized and evaluated by an algorithm.

Lastly the participants' attitude towards AI completely taking over the recruitment process is very negative. The vast majority of them (40%) strongly disagreed to this statement while just 2% strongly agreed. Another decisive stat is that 86% of participants believe that technological advancements in Greece are much slower than the European average, another finding that reflects the relevant literature. In generally respondents feel they can trust AI in terms of objectivity but are very hesitant in trusting the use of it in multiple stages of recruitment in Greece since they feel that their job skills and abilities will potentially be mistaken or not taken into the consideration they should be taken by an algorithm.

Interviews/Qualitative analysis

Interviews' Sample characteristics

Our participants for the interviews are 11 in total, they all work in Greece, in Greek companies or Greek subsidiaries of multinational companies, and none of them work in the same company. Our sample included of 3 participants, characterizing themselves as males and of 8 participants characterizing themselves as females, with an average age of 31 years old (from 24 to 43 years old). They have all completed a level of higher education and are currently working in the HR field.

Analysis characteristics

For the analysis of the qualitative data, deriving from the interviews, we conducted a thematic analysis (2) following the steps of familiarizing with the data (interview transcripts), coding the data, searching for the themes, reexamining the themes, defining the themes and writing of the findings. Due to the size of the sample and the homogeneity of the qualitative data (video-recorded interviews only), we did not use any kind of software for the thematic analysis. It is though suggested for studies with higher data volumes and more heterogenous data. The table of the thematic analysis, along with the interview questions, can be found in the appendices (appendix 3 &4 accordingly) and below the results are presented, in accordance with the relevant literature.

Interviews' results

To begin with, the qualitative analysis revealed four different themes, based on the answers of the interviewees: The use of the AI enabled recruiting tools from the HR specialists, The characteristics of the AI enabled recruiting tools, The AI enabled recruiting tools & the biases, and the AI enabled recruiting tools in comparison with the human. Below we present the results and its relation to the literature.

In regards of the use of the AI enabled recruiting tools, the first theme of the analysis, nine out of the eleven participants stated that they have used in some way the AI enabled recruiting tools, in their present or previous jobs as HR specialists, and another one stated that soon they will employ a tool to help them with the CV screening process. Even though they were positive for the use of the AI enabled recruiting tools, the category “through the whole recruiting process ” was created based on statements such as “the AI enabled recruiting tools should not be used through the whole recruiting process” (7/11), but they should be used “during the first steps of the process” (6/11), mentioning that “the final evaluation should be made by a human specialist” (4/11) and that “the human specialist should be able to intervene through the whole process” (4/11). On the same category, two participants stated that “in the future it is possible that the whole process will be held by the AI enabled recruiting tools” and another two that “the AI enabled recruiting tools can be avoided if the process is well designed”. Thus, when they were asked about the tools they have used or are using, they focused on screening and video-interview tools, with some of them naming them tools, such as HireVue, Talento, Workable, Recrutee, Hired, LinkedIn, Greenhouse, and Talenture. Although most of them have used the AI enabled recruiting tools in their profession, and they support the use of them, at least in some stages of the process, there was a distinction on whether they think that they are widely in use in the market, distinguishing them as “widely in use in big (multinational companies) foreign (not Greek) companies” (4/11), “widely in use in foreign (not Greek companies)” (3/11), “widely in use (without geographical or size distinction)” (2/11), and “not widely in use (without geographical or size distinction)” (2/11).

The second theme of the analysis included the characteristics of the AI enabled recruiting tools, separating them into positive, negative, and desirable ones. The participants would mainly want the AI enabled recruiting tools to be “well designed” (9/11), “impartial” (8/11), “easy for the specialist to use” (7/11), “easy for the applicant” (4/11), and “time effective” (4/11). As for the characteristics the AI enabled recruiting tools have, based on their experience, “workload deduction/eases the specialist’s job” (5/11), “faster/time effective process” (5/11), “automation of the process” (3/11) are the main ones. On the other hand, the specialists noted as the negative characteristics about the AI enabled recruiting tools that “candidates/CVs might be lost” (5/11), “they cannot replace the humans” (4/11), “they are impersonal” (4/11), and “they can be biased/unfair” (3/11).

Combining the categories “trusting the AI enabled recruiting tools”, “AI enabled recruiting tools and biases”, “biases: AI enabled recruiting tools or humans?”, and “Examples of biased AI enabled recruiting tools”, the theme “Biases” was formed. It is quite notable that none of the participants was aware of any example of biased AI enabled recruiting tools and most of them declared that they “trust the AI enabled recruiting tools” (8/11), that it is more likely that “the AI enabled recruiting tools, over humans, to be unbiased” (7/11), that the AI enabled recruiting tools are “not biased” (3/11) or “can be biased because of human intervention” (4/11).

Finally, the last theme, “Human vs AI tools”, was created from the answers of one question “Should the AI enabled recruiting tools be supporting the HR specialists or they can even replace the HR specialists?”. As expected, the answers were “only as supportive” (5/11), “currently as supportive, but in the future, they could replace humans, only in some tasks” (5/11) and “in some companies the process is fully automated, but human factor will always be present” (1/11). The participants did emphasize on the

human touch, the interpersonal communication, the critical thinking, and the empathy that characterizes humans over machines/algorithms.

Discussion

Questionnaires

According to the questionnaire results the sample is in almost identical accordance with the literature review findings. Participants seem to have a positive attitude towards the initial stages of recruitment process becoming subject to forms of AI recruitment tools such as screening and scoring tools despite the fact that just four out of 10 Greeks have ever participated in a recruitment process which made use of AI empowered technologies, the general belief is that those tools are primarily made for objectivity, transparency and fairness throughout the initial stages of the recruitment process this finding is in perfect alignment with the relevant literature, which emphasizes deeply on how beneficial those tools are in terms of inspiring objectivity, transparency, and fairness while constantly working towards improvement in regards to reducing and eventually eliminating potential biases occurring throughout the recruitment process.

Although since according to the relevant literature which states that just a small fraction of companies in Greece utilize those tools participants tend to feel unfamiliar and uncomfortable with the idea of their entire application process becoming an algorithmic assessment entirely. This also reflects the relevant literature stating in regards of applicant anxiety when they are aware of AI existing in the process. Something once again aligned with the relevant literature on the particular matter.

Additionally participants believe that some of their skills may be too complex for an AI tool to assess, this is something that reflects the part in which AI is finding it difficult to properly assess complex and high level soft skills, and taking into consideration the insecurity expressed by the sample towards AI, combined with the fact that those technologies are yet implemented in a very low level, explains the participants caution and negative attitude towards the use of a AI in final stages of recruitment. Finally, despite the fact that 40% of participants have experienced a eye in recruitment the majority believes that Greece falls far behind the European average, that is also in alignment with the literature stating that just three percent of Greek companies utilize AI in general.

Interviews

Our hypothesis in regards of the perceptions of the HR specialists in Greece, based on the initial literature review, was that they would think the AI enabled recruiting tools as objective. After the completion of the literature review and the results of our research, we think our hypothesis has been proved, but the topic itself is a lot more complex.

In our study, the participants seem to know what the AI enabled recruiting tools are and they had gotten in touch with some of them through their professional experience. But to what extent? It is evident, that they were mostly aware of the AI tools that can be used during the CV screening process, and less aware of tools such as AI video-interview tools or AI game assessment tools that can even reveal personality traits of the candidates. That could be explained though, as the majority of them also expressed that the AI enabled recruiting tools should not be used during the whole recruiting process and only be used during the very first stages of the procedure, leaving the final evaluation to the human specialist. Although they were very positive in using the AI enabled recruiting tools, they

would still not prefer the AI tools to be part of the whole procedure and based on previous findings, the reasons behind this can be the complexity of the HR operations and fairness issues, related to the tools, as well (3). When the respondents were asked about the popularity of the tools, again the majority would agree that the AI enabled recruiting tools are mostly used from multinational non-Greek companies (6). In connection to the previous results, it seems that there is no apparent competition around the use of AI tools within the Greek firms, which is also supported in the literature, as the number of the Greek firms that are using AI tools is very small (5, 6). In accordance with Accenture's report, the participants in our research also seem to think that in the future the AI enabled recruiting tools might be able to replace the human specialist in more tasks than in the present. The human presence or "human touch" during the whole recruiting process, as the respondents mentioned, will always be necessary (4). Chui, Manyika and Miremadi (1) found that "the hardest activities to automate with currently available technologies are those that involve managing and developing people (9 percent automation potential) or that apply expertise to decision making, planning, or creative work (18 percent)", which support the finding of the present study, that humans cannot be excluded of the recruiting process and that AI enabled recruiting tools should play a supporting role in the HR operations. As for the respondents in our research, the disability of the AI tools to replace humans is a negative characteristic of the tools as well, someone would think that it is not that they would not want the tools to replace humans. The rest of the characteristics that the respondents reported for the AI tools, positive ones, such as "time effective" and "workload deduction", negative ones, such as "impersonal" and "possibly biased/unfair", or desirable ones, such as "well designed" and "easy to use", are also supported from the literature review and previous research. Finally, the participants of our study seemed to trust that AI tools are more likely to be unbiased than their human counterparts, and supported the idea that if they are biased, the human that developed them is the one to blame. As some participants in Binns et al. (4) research noted that "the system just does what it is supposed to".

Conclusions & Recommendations

The recruitment process is of vital importance for the development of a company. A well-planned recruiting process can grant companies with a superior advantage against their competitors and make them succeed, and so it is out of question why more and more companies are turning their interest into AI solutions, who have already “infiltrated every function in HR” (1). AI is the next big step of the technology and can really help us streamline the recruitment process. Its tools provide candidate screening, video interviewing, sourcing and applicant tracking systems, chatbots, robotic systems and the research continuous, as the eyes of the scientific world are on AI.

The AI applications have ensured reduction in the recruitment costs, have gained valuable time for the modern enterprises, have made recruiters’ job easier and free of all-time supervision, are “fighting” against discriminations and biases, are trying to make business world more environmentally aware and have been revolutionary in overlapping the issues of time and space. In contrast, the risks and the disadvantages of IT and AI in recruitment can limit at some point their benefits. Some tools have been identified as discriminatory, the applications of the unwanted candidates have been countless, the possibility of faking the processes is always open, findings about the job duration and engagement haven’t been as positive as it should, and companies endanger to lose their “personal touch”. It’s obvious that this coin has two sides and none of them should be underestimated.

So the limitations should be taken into consideration and further research is necessary, as the AI and the advanced technologies, are still new entries, especially in Greece. In terms of the best possible ways to eliminate biases and discrimination, on which this study is focused, that would be extremely useful for companies and organizations in data science to increase their levels of diversity in their workforce. Especially when it comes to data science related positions, where the dominance of specific population groups is evident, it is of high importance that those departments turn their efforts into diversity and inclusivity of all the population groups, in order for them to be able to produce algorithms that are unbiased.

Additionally, we believe that it would be of high interest, in terms of increased productivity, if companies and institutions decided to provide information about the recruitment process, whenever they decide to implement some form of artificial intelligence at any point throughout the process. That would decrease participant anxiety and at the same time increase the company’s reputation in terms of transparency in their future recruitment processes. That will also aid job applicants in terms of being aware about the exact way that they are going to be assessed and help them in order to become more and more familiar with the new era of the digital transformation that is taking place all around us. Everything nowadays depends on data, therefore job applicants in Greece and worldwide should learn about emerging technologies in order to be able to compete in the job market and not fall behind in terms of learning and adapting to new technology. Thus, specifically for the Greek companies, we suggest the establishments of trainings related to the modern technologies, so as to catch up with the rest of the rapidly advanced technological world.

Another interesting field of research, that IBM tends to believe that in the future it will be invaluable, is the Quantum technology and how Quantum computers will affect the recruitment process. In regard of the future challenges, certainly to find the passive candidates, who might be the “stars” a company is looking for, can b harsh. One more question to answer is “what If the competitors use better IT tools and hire your possible employees away?”. Also, it is fearful to think about how extended the use of AI might become, that in the future people will be easily replaceable by machines. Finally, more research is needed for the implementation of AI in the recruitment domain in Greece.

Bibliography

Introduction

1. Demeijer, D. (2017). *Making digital HRM work: A study in changes in perceived consequences of e-HRM in the past decade* (Master's thesis, University of Twente).
2. [Cybersecurity Glossary | National Initiative for Cybersecurity Careers and Studies \(cisa.gov\)](#) [Accessed 22 Dec. 2021]
3. Van Esch, P., & Black, J. S. (2019). Factors that influence new generation candidates to engage with and complete digital, AI-enabled recruiting. *Business Horizons*, 62(6), 729-739.
4. Black, J. S., & van Esch, P. (2021). AI-enabled recruiting in the war for talent. *Business Horizons*, 64(4), 513-524.
5. Dessler, G. (2013), Human Resource Management (13th edition). *New Jersey: Pearson Prentice Hall*.
6. Azeem, M. F., & Yasmin, R. (2016). HR 2.0: linking Web 2.0 and HRM functions. *Journal of organizational change management*, Vol. 29. Issue: 5, pp.686-712.
7. Faliagka, E., Tsakalidis, A., & Tzimas, G. (2012). An integrated e-recruitment system for automated personality mining and applicant ranking. *Internet research*, 22(5), 551–568.
8. Barber, L. (2006). e-Recruitment Developments. Retrieved from <http://www.employment-studies.co.uk> [Accessed 10 Oct. 2021].
9. Loukides, M. (2011) *What is data science?*. " O'Reilly Media, Inc."
10. <https://www.partnershiponai.org/> [Accessed 10 Oct. 2021].
11. <https://ideal.com/ai-recruiting/> [Accessed 10 Oct. 2021].
12. Kaplan, A.M., & Haenlein, M. (2019). Siri, Siri, in my hand: Who's the fairest in the land? On the interpretations, illustrations, and implications of artificial intelligence. *Business Horizons*, 62(1), pp. 15-25.
13. Rao, A. S., Verweij, G., & Cameron, E. (2017). "Sizing the prize: what's the real value of AI for your business and how can you capitalise? PwC."
14. Castellanos, S. (2019). HR Departments Turn to AI-Enabled Recruiting in Race for Talent. [online] WSJ. Available at: <https://www.wsj.com/articles/hr-departments-turn-to-ai-enabled-recruiting-in-race-for-talent-11552600459> [Accessed 10 Oct. 2021].
15. <https://www2.deloitte.com/insights/us/en/focus/human-capital-trends.html> [Accessed 10 Oct. 2021].
16. Jia, Q., Guo, Y., Li, R., Li, Y., & Chen, Y. (2018). A Conceptual Artificial Intelligence Application Framework in Human Resource Management. ICEB 2018 Proceedings. 91. <https://aisel.aisnet.org/iceb2018/91>
17. Cohen, T. (2019). How to leverage artificial intelligence to meet your diversity goals. Strategic HR Review.

18. <https://www.sev.org.gr/ekdoseis/techniti-noimosyni-ena-aparaitito-alma-gia-tis-epicheiriseis-ta-dedomena-simera-kai-oi-protaseis-tou-sev/> [Accessed 10 Oct. 2021].
19. Lengnick-Hall, Mark L., and Steve Moritz. "The impact of e-HR on the human resource management function." *Journal of labor research* 24.3 (2003): 365-379.
20. https://www.accenture.com/_acnmedia/Accenture/Redesign-Assets/DotCom/Documents/Local/1/Accenture-With-AI-to-the-Future-2019.pdf#zoom=50 [Accessed 10 Oct. 2021].
21. <https://hrpro.gr/hirevue-proteraiotita-to-di-stis-proslipseis-gia-ta-stelechi-tou-hr/> [Accessed 10 Oct. 2021].
22. <https://hrpro.gr/nea-synergasia-microsoft-hellas-kai-regeneration/> [Accessed 10 Oct. 2021].

Tools

1. Van Esch, P., & Black, J. S. (2019). Factors that influence new generation candidates to engage with and complete digital, AI-enabled recruiting. *Business Horizons*, 62(6), 729-739.
2. Black, J. S., & van Esch, P. (2020). AI-enabled recruiting: What is it and how should a manager use it?. *Business Horizons*, 63(2), 215-226.
3. <https://ideal.com/resume-screening-tools/> [Accessed 10 Oct. 2021].
4. <https://www.ft.com/content/e2e85644-05be-11e8-9650-9c0ad2d7c5b5> [Accessed 10 Oct. 2021].
5. Hong, J. W., Choi, S., & Williams, D. (2020). Sexist AI: An experiment integrating CASA and ELM. *International Journal of Human-Computer Interaction*, 36(20), 1928-1941.
6. Min, J., Kim, S., Park, Y., & Sohn, Y. W. (2018). A Comparative Study of Potential Job Candidates' Perceptions of an AI Recruiter and a Human Recruiter. *Journal of the Korea Convergence Society*, 9(5), 191-202. <https://doi.org/10.15207/JKCS.2018.9.5.191>
- 7.
8. <https://www.aihr.com/blog/artificial-intelligence-talent-acquisition/> [Accessed 10 Oct. 2021].
9. Skilton, M., & Hovsepian, F. (2018). *The 4th Industrial Revolution: Responding to the Impact of Artificial Intelligence on Business* (1st ed. 2018.). Cham: Springer International Publishing: Imprint: Palgrave Macmillan.
10. Jakhar, D., & Kaur, I. (2019). Artificial intelligence, machine learning and deep learning: definitions and differences. *Clinical and experimental dermatology*, 45(1), 131-132.
11. <https://www.marshmcclennan.com/content/dam/mmc-web/insights/publications/2019/feb/gl-2019-global-talent-trends-study.pdf> [Accessed 10 Oct. 2021].

12. Ved, S., Kaundanya, N.S. & Panda, O.P. (2016). Applications and Current Achievements in the field of Artificial Intelligence. *Imperial Journal of Interdisciplinary research*, 2(11), 932-936
13. Ivaschenko A., Milutkin M. (2019) HR Decision-Making Support Based on Natural Language Processing. In: Kravets A., Groumpos P., Shcherbakov M., Kultsova M. (eds) *Creativity in Intelligent Technologies and Data Science. CIT&DS 2019. Communications in Computer and Information Science*, vol 1083. Springer, Cham.
14. Black, J. S., & van Esch, P. (2021). AI-enabled recruiting in the war for talent. *Business Horizons*, 64(4), 513-524.
15. Kaushal, N., Kaurav, R. P. S., Sivathanu, B., & Kaushik, N. (2021). Artificial intelligence and HRM: identifying future research Agenda using systematic literature review and bibliometric analysis. *Management Review Quarterly*, 1-39.
16. <https://ideal.com/ai-recruiting/> [Accessed 10 Oct. 2021].
17. Cohen, T. (2019). How to leverage artificial intelligence to meet your diversity goals. *Strategic HR Review*.
18. <https://medium.com/@darshitakumar01/how-ai-is-redefining-the-traditional-recruitment-process-eed76f00f5ee> [Accessed 10 Oct. 2021].
19. <https://hrpro.gr/hirevue-proteraiotita-to-di-stis-proslipseis-gia-ta-stelechi-tou-hr/> [Accessed 10 Oct. 2021].
20. <https://hrpro.gr/synergasia-owiwi-me-papastratos/> [Accessed 10 Oct. 2021].
21. [Ερευνα PFB @ Τεχνολογία, Τεχνητή Νοημοσύνη και Στρατηγική Ανθρώπινου Δυναμικού | People for Business \(pfb-group.com\)](https://www.pfb-group.com/) [Accessed 10 Oct. 2021].
22. Kaplan, A., & Haenlein, M. (2019). Siri, Siri, in my hand: Who's the fairest in the land? On the interpretations, illustrations, and implications of artificial intelligence. *Business Horizons*, 62(1), 15-25.
23. Kulkarni, S. B., & Che, X. (2019). Intelligent software tools for recruiting. *Journal of International Technology and Information Management*, 28(2), 2-16.

Benefits & Challenges

1. Abdelday, M. M., & Aldulaimi, S. H. (2020). Trends and opportunities of artificial intelligence in human resource management: Aspirations for public sector in Bahrain. *INTERNATIONAL JOURNAL OF SCIENTIFIC & TECHNOLOGY RESEARCH* VOLUME 9, ISSUE 01,.
2. Nawaz, N. (2019). Artificial intelligence is transforming recruitment effectiveness in CMMI level companies. *International Journal of Advanced Trends in Computer Science and Engineering*.
3. Premusic, T. C. (2012). Digital Staffing: The Future of Recruitment-by-Algorithm. *Harvard Business Review*.
4. Premusic, T. C. (2019). Will AI Reduce Gender Bias in Hiring? *Harvard Business Review*.

5. Polli, F. (2019). Using AI to Eliminate Bias from Hiring. Harvard Business Review. <https://hbr.org/2019/10/using-ai-to-eliminate-bias-from-hiring>
6. Sweeney, E. (2021). AI can help companies remove bias in the hiring process, speed up recruitment, and prevent employees from quitting, experts say. Business Insider.
7. Tambe, P., Cappelli, P., & Yakubovic, V. (2019). Artificial Intelligence in Human Resources Management: Challenges and a Path Forward. California Management Review.
8. Patrick van Esch, J., & Black, S. (2019). Factors that influence new generation candidates to engage with and complete digital, AI-enabled recruiting. *Business Horizons*, Volume 62, Issue 6, Pages 729-739, ISSN 0007-6813, <https://doi.org/10.1016/j.bushor.2019.07.004>
9. [artificial-intelligence-in-talent-acquisition.pdf \(oracle.com\)](#) [Accessed 10 Oct. 2021].
10. Kulkarni, S. B., & Che, X. (2019). Intelligent software tools for recruiting. *Journal of International Technology and Information Management*, 28(2), 2-16.
11. Dr Nawaz, N. (2019). Robotic Process Automation for Recruitment Process. *International Journal of Advanced Research in Engineering and Technology*, 10(2), pp. 608-611.
12. Hong, J., Choi, S., & Williams, D. (2020). Sexist AI: An Experiment Integrating CASA and ELM, *International Journal of Human–Computer Interaction*, 36:20, 1928-1941, <https://doi.org/10.1080/10447318.2020.1801226>
13. Johansson, J., & Herranen, S. (2019). The application of Artificial Intelligence (AI) in Human Resource Management: Current state of AI and its impact on the traditional recruitment process (Dissertation). Retrieved from <http://urn.kb.se/resolve?urn=urn:nbn:se:hj:diva-44323>
14. <https://www.sev.org.gr/ekdoseis/techniti-noimosyni-ena-aparaitito-alma-gia-tis-epicheiriseis-ta-dedomena-simera-kai-oi-protaseis-tou-sev/> [Accessed 10 Oct. 2021].
15. https://www.accenture.com/_acnmedia/Accenture/Redesign-Assets/DotCom/Documents/Local/1/Accenture-With-AI-to-the-Future-2019.pdf#zoom=50 [Accessed 10 Oct. 2021].
16. Floridi, L., Cowls, J., Beltrametti, M. et al. (2018). AI4People—An Ethical Framework for a Good AI Society: Opportunities, Risks, Principles, and Recommendations. *Minds & Machines* 28, 689–707. <https://doi.org/10.1007/s11023-018-9482-5>
17. 17. Yam, J., & Skorburg, J.A. (2021). From human resources to human rights: Impact assessments for hiring algorithms. *Ethics Inf Technol* 23, 611–623. <https://doi.org/10.1007/s10676-021-09599-7>
18. 18. Fritts, M., Cabrera, F. (2021). AI recruitment algorithms and the dehumanization problem. *Ethics Inf Technol* 23, 791–801. <https://doi.org/10.1007/s10676-021-09615-w>
19. 19. Oswal, N., Khaledi, M., & Alarmoti, A. (2020). RECRUITMENT IN THE ERA OF INDUSTRY 4.0: USE OF ARTIFICIAL INTELLIGENCE IN RECRUITMENT AND ITS IMPACT. *Palarch's Journal of Archeology of Egypt*.
20. 20. Sinar, E., L.Ray, R., & L.Canwell, A. (2018). HR Leaders need stronger data skills. Harvard Business Review. <https://hbr.org/2018/10/hr-leaders-need-stronger-data-skills>

21. Bogen, M. (2019). All the Ways Hiring Algorithms Can Introduce Bias. Harvard Business Review. <https://hbr.org/2019/05/all-the-ways-hiring-algorithms-can-introduce-bias>
22. White, S. K. (2021). AI in hiring might do more harm than good. CIO. <https://www.cio.com/article/189212/ai-in-hiring-might-do-more-harm-than-good.html>
23. Wajcman, J., & Young, E. (2021). Women in data science and AI. The Alan Turing Institute. <https://www.turing.ac.uk/research/research-projects/women-data-science-and-ai>
24. Patrick van Esch, J., Black, S., & Ferolie, J. (2019). Marketing AI recruitment: The next phase in job application and selection, Computers in Human Behavior, Volume 90, Pages 215-222, ISSN 0747-5632. <https://doi.org/10.1016/j.chb.2018.09.009>.

Biases

3. Drew, E., & Canavan, S. (2020). *The Gender-sensitive University: A Contradiction in Terms?* (p. 208). Taylor & Francis.
4. Hong, J. W., Choi, S., & Williams, D. (2020). Sexist AI: An experiment integrating CASA and ELM. *International Journal of Human-Computer Interaction*, 36(20), 1928-1941. <https://doi.org/10.1080/10447318.2020.1801226>
5. Min, J., Kim, S., Park, Y., & Sohn, Y. W. (2018). A Comparative Study of Potential Job Candidates' Perceptions of an AI Recruiter and a Human Recruiter. *Journal of the Korea Convergence Society*, 9(5), 191-202. <https://doi.org/10.15207/JKCS.2018.9.5.191>
6. Skilton, M., & Hovsepian, F. (2018). *The 4th Industrial Revolution: Responding to the Impact of Artificial Intelligence on Business* (1st ed. 2018.). Cham: Springer International Publishing: Imprint: Palgrave Macmillan.
7. Xavier, F., & van, N. T. (2021). Bias and Discrimination in AI: A Cross-Disciplinary Perspective. *IEEE Technology and Society Magazine*, 40(2).
8. Elizabeth, N. I. AI ethical bias: A case for AI vigilantism (Allantism) in shaping the regulation of AI. *International Journal of Law and Information Technology*.
9. David, H. (1988). Quantifying inductive bias: AI learning algorithms and Valiant's learning framework. *Artificial Intelligence*, 36(2), .
10. Cynthia, W. (2019). Engineering Bias in AI. *IEEE Pulse (formerly IEEE Engineering in Medicine and Biology Magazine)*, 10(1).
11. Ramya Srinivasan and Ajay Chander. 2021. Biases in AI systems. *Commun. ACM* 64, 8 (August 2021), 44–49. <https://doi.org/10.1145/3464903>
12. Justin Richards, Krishna Gummadi, Combating Bias in AI, *ITNOW*, Volume 60, Issue 4, Winter 2018, Pages 62–63, <https://doi.org/10.1093/itnow/bwy111>
13. Toon, C., & Eirini, N. (2021). Introduction to The Special Section on Bias and Fairness in AI. *ACM SIGKDD Explorations Newsletter*, 23(1).

14. Akter, S., McCarthy, G., Sajib, S., Michael, K., Dwivedi, Y. K., D'Ambra, J., & Shen, K. N. (2021). Algorithmic bias in data-driven innovation in the age of AI. *International Journal of Information Management*, 60, 102387.
15. Caven, V., & Nachmias, S. (2018). *Hidden Inequalities in the Workplace: A Guide to the Current Challenges, Issues and Business Solutions* (1st ed. 2018.). Cham: Springer International Publishing: Imprint: Palgrave Macmillan.
16. John, S., & J., F. T. (2004). Advances in biased net theory: Definitions, derivations, and estimations. *Social Networks*, 26(2),.
17. Sorel, C., & Eyal, G. (2006). Definition and Measurement of Selection Bias: From Constant Ratio to Constant Difference. *Journal of Educational Measurement*, 43(2),.
18. Mathis, R. and Jackson, J. (2010). *Human Resource Management*. 13th ed. Mason, OH: South – Western Cengage Learning.
19. Jie Zhang, Jamal Bentahar, Rino Falcone, Timothy J. Norman, and Murat Şensoy. 2019. Introduction to the Special Section on Trust and AI. *ACM Trans. Internet Technol.* 19, 4, Article 44e (November 2019), 3 pages. <https://doi.org/10.1145/3365675>
20. Erin, B., & Jules, H. (2020). Bias in Context: An Introduction to the Symposium. *Journal of Applied Philosophy*, 37(2), .
21. Catherine, T., & Alessia, P. (2021). Carry-over of attentional settings between distinct tasks: A transient effect independent of top-down contextual biases. *Consciousness and Cognition*, 90, .
22. Wang, M., & Chen, Y. (2004). Age Differences in the Correction Processes of Context-Induced Biases: When Correction Succeeds. *Psychology and Aging*, 19(3), 536–540. [doi:10.1037/0882-7974.19.3.536](https://doi.org/10.1037/0882-7974.19.3.536)
23. Raveendra, Penumadu & Satish, Y. & Singh, Padmalini. (2020). Changing Landscape of Recruitment Industry: A Study on the Impact of Artificial Intelligence on Eliminating Hiring Bias from Recruitment and Selection Process. *Journal of Computational and Theoretical Nanoscience*. 17. 4404-4407. [doi:10.1166/jctn.2020.9086](https://doi.org/10.1166/jctn.2020.9086).
24. Whittaker, M., Alper, M., Bennett, C. L., Hendren, S., Kaziunas, L., Mills, M., ... & West, S. M. (2019). Disability, bias, and AI. AI Now Institute.
25. Yarger, L., Payton, F. C., & Neupane, B. (2019). Algorithmic equity in the hiring of underrepresented IT job candidates. *Online Information Review*.
26. Whysall, Z. (2018). Cognitive biases in recruitment, selection, and promotion: The risk of subconscious discrimination. *Hidden inequalities in the workplace*, 215-243.

Methodology

1. Saunders, M., Lewis, P., & Thornhill, A. (2019). *Research methods for business students eighth edition*. Pearson education.
2. Ίσαρη, Φ., Πουρκός, Μ. (2015). Οργάνωση, Ταξινόμηση, Ανάλυση και Αξιολόγηση Ποιοτικών Δεδομένων. Εκδόσεις Κάλλιπος. *Ποιοτική μεθοδολογία έρευνας* (σελ. 115 – 127).

Discussion

1. <https://www.mckinsey.com/business-functions/mckinsey-digital/our-insights/where-machines-could-replace-humans-and-where-they-cant-yet> [Accessed 10 Oct. 2021].
2. https://www.accenture.com/_acnmedia/Accenture/Redesign-Assets/DotCom/Documents/Local/1/Accenture-With-AI-to-the-Future-2019.pdf#zoom=50 [Accessed 10 Oct. 2021].
3. Park, H., Ahn, D., Hosanagar, K., & Lee, J. (2021, May). Human-AI Interaction in Human Resource Management: Understanding Why Employees Resist Algorithmic Evaluation at Workplaces and How to Mitigate Burdens. In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems* (pp. 1-15).
4. Binns, R., Van Kleek, M., Veale, M., Lyngs, U., Zhao, J., & Shadbolt, N. (2018, April). 'It's Reducing a Human Being to a Percentage' Perceptions of Justice in Algorithmic Decisions. In *Proceedings of the 2018 Chi conference on human factors in computing systems* (pp. 1-14).
5. <https://www.sev.org.gr/ekdoseis/techniti-noimosyni-ena-aparaitito-alma-gia-tis-epicheiriseis-ta-dedomena-simera-kai-oi-protaseis-tou-sev/> [Accessed 10 Oct. 2021].
6. https://www.accenture.com/_acnmedia/Accenture/Redesign-Assets/DotCom/Documents/Local/1/Accenture-With-AI-to-the-Future-2019.pdf#zoom=50 [Accessed 10 Oct. 2021].

Recommendations

1. Castellanos, S. (2019). HR Departments Turn to AI-Enabled Recruiting in Race for Talent. [online] WSJ. Available at: <https://www.wsj.com/articles/hr-departments-turn-to-ai-enabled-recruiting-in-race-for-talent-11552600459> [Accessed 10 Oct. 2021].

Appendix

1)Data requirements table

<https://linksharing.samsungcloud.com/xtnzo7IVF5aL>

2) Questionnaires

<https://forms.gle/nbxYrQ5tAShfF68Y6>

3) Thematic analysis table

The use of AI enabled recruiting tools from the HR specialists	Used AI enabled recruiting tools	Yes (9)	No (1)	Have read about them (1)				
	Which AI enabled recruiting tools	Screening tools (2)	Video-interview (3)	Hirevue, Talenteo, Recrutee, Hired, LinkedIn, Greenhouse, Talenture, Workable (1)				
	On which stage of the procedure	During the first stages (6)	It should not be part of all the stages (7)	The final evaluation from the human specialist (4)	In the future, possibly in all the stages (2)	Human should be able to interfere during the whole procedure (4)	If the process is well established, to not be used (2)	
		Payroll (2)						
	Popularity	Popular in Multinational big companies and/or abroad (4)		Yes, they are commonly in use (2)	No, they are not commonly in use (2)	Mainly in multinational companies (3)		
	Investment	Yes (6)	Not the current one, the previous yes (2)	No but soon yes (1)	Yes, and soon more (1)			
No (1)								
The characteristics of the AI enabled recruiting tools	Desirable characteristics	Easy for the specialist to use (7)	Easy for the candidate to use (4)	Saving time (4)	Unbiased (8)	Well designed (9)	To have human characteristics (2)	Video (1)
	Positive characteristic	Reduction of workload/easier job for the HR specialist (5)	Time release/faster process (5)	Process automation (3)	More inclusivity (1)	Increased quality (1)	Provided data (1)	Less human capital (1)
	Negative characteristics	Bad design of the tools, risking the loss of CVs/Candidates (5)		Impersonal (4)	Unfair/biased (3)	Does consider the human (2)	Discourages the candidate (1)	They cannot replace humans (4)
The AI enabled recruiting	Trust the AI tools	Yes (8)	Not now, but in the future yes (2)	No, I prefer not to use them (1)				

tools and the biases	(Un)Biased	Because of human interaction, the tools have bias (4)		Maybe in race (1)	Yes, they do mistakes (1)	They cannot be 100% unbiased (1)	The tools are not biased (3)	N/a (1)
	Get unbiased – Human vs AI	The AI tools (7)	If humans get unbiased, then the tools too (2)				Human (1)	Equally (1)
	Examples of biased AI enabled recruiting tools							None (11)
The AI enabled recruiting tools in comparison with the human counterpart	Supporting or replacing the HR specialists	For now, only supportive, in the future partial replacement of humans (5)	Only supporting (5)	Some companies have automated the process, but always with the human factor (1)				

4) Interview questions

Έχετε έρθει σε επαφή με κάποιο εργαλείο τεχνητής νοημοσύνης στην εργασία σας σαν μέλος HR Ανθρωπίνου Δυναμικού;

Παραδείγματα: εργαλείο το οποίο βάσει βιογραφικών και με τη χρήση λέξεων σου εμφανίζει τα πιο ταιριαστά, ή βίντεο

→ Ναι, άρα ρωτάμε την 11

→ Όχι, άρα ρωτάμε τη 12

Γενικές ερωτήσεις για τα εργαλεία τεχνητής νοημοσύνης και τη χρήση τους στο HR

1. Θεωρείται πως η χρήση των εργαλείων τεχνητής νοημοσύνης, για τις ανάγκες του Ανθρωπίνου Δυναμικού, είναι διαδεδομένη;

2. Ποια χαρακτηριστικά θα πρέπει να έχει ένα εργαλείο τεχνητής νοημοσύνης κατά τη γνώμη σας;

Θα μπορούσε να είναι τεχνικής φύσεως (κάποια ιδιότητα), χαρακτηριστικά όσον αφορά τη χρήση του κλπ.

Οι απόψεις τους ειδικά για τα εργαλεία τεχνητής νοημοσύνης για τις διαδικασίες του Ανθρωπίνου Δυναμικού

3. Θα πρέπει τα εργαλεία τεχνητής νοημοσύνης να χρησιμοποιούνται σε όλα τα στάδια της διαδικασίας πρόσληψης; Για ποιους λόγους;

Η χρήση των εργαλείων τεχνητής νοημοσύνης για την πρόσληψη υποψηφίων στην/στον εταιρεία/οργανισμό που οι ίδιοι απασχολούνται

4. Πόσο θετικά ή αρνητικά επηρεάζει η χρήση εργαλείων τεχνητής νοημοσύνης τη διαδικασία πρόσληψης;
5. Η εταιρεία σας έχει επενδύσει σε εργαλεία τεχνητής νοημοσύνης για την πρόσληψη υποψηφίων;
6. Ποια εργαλεία τεχνητής νοημοσύνης χρησιμοποιείται στην εταιρεία σας στη διαδικασία πρόσληψης;

Τα εργαλεία τεχνητής νοημοσύνης και οι HR Professionals

7. Θεωρείται πως τα εργαλεία τεχνητής νοημοσύνης στην επιλογή και πρόσληψη προσωπικού λειτουργούν υποστηρικτικά στην εργασία ενός επαγγελματία ή μπορούν και να τον αντικαταστήσουν;
8. Εμπιστεύεστε τα μέσα τεχνητής νοημοσύνης ή θεωρείται πως ο ανθρώπινος παράγοντας είναι αναπόσπαστο μέρος της διαδικασίας πρόσληψης;

Τα εργαλεία τεχνητής νοημοσύνης και οι απόψεις τους για τις προκαταλήψεις

9. Κατά πόσο θεωρείται πως τα εργαλεία τεχνητής νοημοσύνης είναι απαλλαγμένα από προκαταλήψεις/διακρίσεις;
10. Θεωρείται πως είναι πιο εφικτό να απαλλαχτούν από τις προκαταλήψεις/διακρίσεις τα εργαλεία τεχνητής νοημοσύνης ή οι καλά εκπαιδευμένοι επαγγελματίες Ανθρώπινου Δυναμικού;
11. **Υπήρξε κάποιο παράδειγμα, βάσει της εμπειρίας σας, όπου να αντιληφθήκατε πως ένα εργαλείο τεχνητής νοημοσύνης που χρησιμοποιούσατε, μεροληπτούσε κατά μίας πληθυσμιακής ομάδας;
12. ***Γνωρίζετε κάποιο παράδειγμα εργαλείου τεχνητής νοημοσύνης, το οποίο να αποδείχτηκε πως μεροληπτούσε κατά μίας πληθυσμιακής ομάδας;