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Bachelor's Thesis

Legal and Ethical Implications of Artificial Intelligence Applications in Recruiting Processes

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Abstract

The development of artificial intelligence (AI) changed the way we work today. Consequently, AI also changed the way companies employ their workers due to an increasing number of modern recruiting software that leverages machine learning algorithms. As AI applications become more important for transformation of business processes, both public authorities and researchers aim to ensure their lawful and ethical usage. They pursue the goal to align the best ethical AI practices with existing legislation by means of creating guidelines and regulations for AI recruiting applications. This thesis provides an overview of the services on the AI recruiting software market and analyses existing guidelines and regulations regarding AI applications in the European Union (EU). Based on this analysis, we develop an assessment framework for ethical and legally compliant AI tailored to be applied to recruiting software, including corresponding practical recommendations. We also apply this framework to evaluate the compliance of open-source AI recruiting software prototypes, discuss its benefits and limitations.

Contents

1 Introduction

The rapid development of AI in recent years has been encouraging more businesses to integrate novel AI tools into their processes. According to a McKinsey report [110] published in 2021, 56% of companies globally adopted AI in at least one function. In the year 2021, total private investment in AI reached $93.5 billion [170] and $15 billion in total funding in the first quarter of 2022 [21]. At the same time, investments in human capital are proved to be of great importance for management [138][39]. The need for attracting and retaining knowledge workers stimulates companies to turn to innovative practices in Human Resources (HR) and recruiting in the *"war for talent"* [14][75]. We are observing an increase in adoption of AI recruiting software as an assistance or replacement for traditional recruiting processes as businesses are exploring ways to improve their talent acquisition strategies and reduce costs [94][5]. In their 2018 survey [100], LinkedIn highlighted AI and data usage among the biggest trends in recruiting with 76% of 9000 respondents believing that *"AI's impact on recruiting will be at least somewhat significant"*. The global market for recruiting software is estimated to reach a value of $3.85 billion by 2028 with AI being the main trend [103]. Studies show that companies that implemented AI-enabled screening tools managed to reduce their time-to-hire by, on average, 62.5% [13]. Several companies reported that AI made their hiring process more cost-efficient, fast and effective. In 2017, IBM claims to have saved $107 million as a result of AI integration in their HR processes [62]. By including video interviews analysed by AI in their hiring process, Unilever managed to significantly reduce their time-to-hire from four months to four weeks, as well as expand their outreach to recent graduates from 840 universities with analogue technique to 2600 with AI at a lower cost [52]. Using a different approach, one of the largest American trucking company U.S.Xpress reported a 40 % increase in the number of highly skilled hires thanks to conversational AI bot [102].

The increasing integration of AI in business operations concerning the general public raises a series of difficult ethical questions about transparency, explainability and accountability of AI decision-making [126]. There are substantial concerns regarding discriminatory practices and non-transparency of decisions made by AI that a machine cannot be held accountable for, and this issue must be considered carefully in recruiting [114]. Decisions made by hiring managers have long-term consequences: unemployment, job loss and dissatisfaction with working conditions lead to poorer physical health and happiness of individuals [71][169]. These negative effects can poten-

tially build up to form serious issues for society as a whole such as increased crime rates [36] especially among historically discriminated and disadvantaged communities [81]. These reasons led EU legislators to impose multiple non-discrimination laws and directives in employment [76] to ensure fair and non-disadvantageous practices in the employee selection process. However, not all employment regulations can be directly applied to properly verify legal compliance of AI algorithms in recruiting practices [96]. The increase in the adoption of AI recruiting software has a direct influence on employment, which makes it a matter of public interest and political importance. This fact calls for new regulations and ethical guidelines to establish best practices for the development of AI recruiting software. These measures aim to ensure an appropriate level of fairness towards job candidates and employees so that they match EU employment standards and comply with legal regulations.

In this thesis, we aim to answer the following question: "How can we combine best practices, ethical guidelines and legal regulations in the EU in a practical framework for compliance assessment of AI recruiting software?" In order to do this, we will analyse the following questions:

1. How can AI be used to improve recruiting processes from a business perspective?
2. What are the legal regulations and ethical guidelines that could be applied to AI recruiting software in the EU?
3. How can we combine legal and ethical guidelines in one framework for AI recruiting regulation?

2 Methodology

We conducted a literature review to answer each of the posed questions and used design science methods to create our framework. First, we research AI recruiting vendors and services they offer to gain an overview of the market and current trends in this field. Then, we analyse existing guidelines, frameworks, and regulations of AI for similarities and disparities that we would need to bridge with our developed framework. At last, we propose a framework for establishing fair practices in development and usage of AI recruiting software. Further in this chapter, we explain our methods for each of the steps in detail.

2.1 Overview of AI services in recruiting

To provide a thorough review of AI recruiting services, we decided to create a table of popular recruiting software vendors and AI services they offer. To choose the vendors to analyse in detail, we searched for papers, reports, and websites mentioning *AI recruiting software, AI hiring software, AI technology, predictive hiring* and similar keywords on Google[1] and Google Scholar[2]. The detailed results of this research are presented in a table in Appendix A, where 66 AI recruiting providers are ranked based on the number of their occurrences in analysed 25 sources. In the final table (Figure 1) we included 23 vendors that had more than 4 occurrences and are considered popular in our method. Additionally, we included 2 other vendors (Checkr and AmazingHiring) that, although did not have a sufficiently high number of occurrences in the studied literature, specialise in comparatively rare areas of AI recruiting (cross-platform data enrichment and background checks), and therefore should also be considered to complete our review. We take into account AI-enhanced tools that directly contribute to recruiting activities such as creating a candidate pool (*sourcing*, *conversational AI*), reviewing resumes and verifying information (*CV/profile screening*, *cross-platform insights*, *conversational AI*) and conducting candidate assessments (*video interview screening*, *psychometric testing*). The "*diversity hiring*" feature was added to highlight which vendors openly claim to actively mitigate algorithmic bias and to support the diversification of hires in their software. However, we excluded the vendors that only provide recommendations on

[1] https://google.com/
[2] https://scholar.google.com/

how to use their tools for diversity hiring, rather than explaining how their system already ensures this practice by design, since we do not consider the recommendation for the user effort to be a service provided by the developer.

2.2 Guidelines overview

Our analysis is based on European and international guidelines and legal documents regarding automatic data processing, automated decision-making and AI. To create a comprehensive overview, we summarised relevant guidelines in a table (Figure 2) similar to one in Hagendorff's research paper [64]. We aim to provide deeper insights into EU regulations and guidelines represented by acts issued by European Parliament and European Council [46][47], European Commission [72] and Council of Europe [29] as well as those of international organisations that have EU member states as members (UNESCO [161], OECD [123]). In addition, we consider guidelines composed by academic community (AI Now Institute [41], AI4People [42], The Oxford Munich Code of Conduct [61], The Alan Turing Institute [92], and guidelines on preventing malicious usage of AI from collaboration of multiple universities [43]), non-profit organisations (Data Science & Ethics Group [33], Dataethics [159], Partnership on AI(PAI) [128], Amnesty International & Access Now [7], The Public Voice[154]) and industry representatives, among which are individual IT corporations that contribute to AI development (Google [60], IBM [77], Microsoft [115]) and professional associations (IEEE [153], Ethics Council HR Tech 2021 [44], Syntec Numérique & CIGREF [152]). The guidelines were sourced and categorised with the help of AI Ethics Guidelines Global Inventory[3], Google Scholar and EUR-Lex[4]. When choosing guidelines to include, we focused on their comprehensiveness, timely relevance and practicality. Moreover, we did not include guidelines that are targeted at a specific industry (other than HR) or national-level regulations. We selected Google, IBM, and Microsoft to represent the guidelines of the private sector due to their contribution to the development of fair AI assessment software: Fairlearn[5] developed by Microsoft, AI Fairness 360[6] by IBM and Responsible AI Toolkit[7] by Google-owned TensorFlow[8]. The

[3]https://inventory.algorithmwatch.org/
[4]https://eur-lex.europa.eu/homepage.html
[5]https://fairlearn.org/
[6]https://aif360.mybluemix.net/
[7]https://tensorflow.org/responsible_ai/
[8]https://www.tensorflow.org/

overview includes guidelines and frameworks for automated decision-making systems, automatic data processing, data protection and AI regulations.

The contents of the guidelines were later studied and screened for common keywords like *data privacy*, *transparency*, *fairness* etc. Due to the different nature of guidelines and their wording, we had to summarise mentioned principles in general concepts and analyse them in depth to properly categorise them. Considering the purpose of our table to serve as a basis for the AI assessment framework, we did not include principles that cannot be directly used for evaluating ethical and legal compliance of recruiting software (e.g. military AI systems, robots, issues regarding unemployment due to replacement of workers by AI). To further increase the value of this analysis, we also looked for regulations that acknowledge AI usage in HR, candidate selection or recruiting, and can be applied there either directly or implicitly.

2.3 Framework

When designing the evaluation framework, we closely followed the principles of the design science research methodology (DSRM) proposed by Peffers [130], which is used in the field of information systems research. DSRM consists of 6 key activities, from the identification of the problem to the evaluation and communication of the results. After *identifying* the problem presented in the introduction, the *solution objectives* were defined, which act as the goal for our framework. The result of the *design and development* activity is the framework for ethical and legal evaluation of AI recruiting software. Upon completion of the framework, we *demonstrate* its application in case studies where we evaluate open-source AI algorithm prototypes of services described in the overview of AI services in recruiting. In the process of practical application of the framework, it was *evaluated* with regard to the objectives defined earlier and updated respectively in an iterative manner. Subsequently, the results of the framework development are summarised and *communicated* in this thesis.

The ethical and legal guidelines that were analysed in the course of creation of the guidelines overview table served as a basis for framework development. Additionally, we used "AI Fairness Checklist" by Microsoft [105], "HHS Trustworthy AI Playbook" [167], and "People + AI Guidebook" [131] for more practical guidelines. We detected the most common principles found in the ethical and legal guidelines, and analysed AI development and recruit-

ing processes to select the necessary activities to consider. Moreover, we researched legal documents to provide the users of the framework with sources for exact regulations of every step. Additionally, we suggest tools and offer recommendations that were accumulated in the course of our research to assist the users in correctly exercising the framework activities.

2.4 Case studies

To apply and demonstrate our framework, we selected 4 research papers that present prototypes of algorithms covering different services AI software normally offers. By analysing research papers accompanying these algorithms, we could also indirectly apply the non-technical stages of problem analysis and working with algorithm's output by reviewing researchers' motivations, considerations, and conclusions. Papers by Singh et al. [146] and Le et al. [90] propose CV screening tools, Kaya et al. [85] focus on video interview screening, and Siswanto et al. [84] present an interview chatbot. These papers were selected due to the most detailed descriptions of the algorithms and motivation among other studies we considered. Since access to the source code for the analysed prototypes is restricted, this evaluation is based on the proposed methodology and technical details provided by the authors rather than our independent evaluation of the algorithms. Due to the nature of the analysed papers, we were unable to assess the prototypes they present at certain stages of the framework (e.g. data transfer and storage, risk assessment) since they were not covered in the source. The application of the framework was performed in the format of a checklist assessment, measuring the mentions of relevant concepts rather than the actuality of their implementation by the authors. Therefore, our assessment of the prototypes does not claim that the authors did not consider the criteria that were left blank in Figure 5, it only states they were not detected or applicable to the prototype.

3 AI in recruiting

AI is a technology that leverages various computational techniques ranging from traditional human-explainable, deterministic, rule-based algorithms (e.g. decision trees, search algorithms, table-driven agents) to advanced computationally intense and requiring a large amount of data systems (e.g. neural networks, deep learning, natural language processing and generating) [70]. In general, AI could potentially be seen as a complex algorithm that resembles human cognitive behaviour in handling non-trivial tasks and may include learning functions that improve its performance over time [25]. This quality makes it a powerful tool for automating complex business operations, so it found its broad application in HR and recruiting. We define AI recruiting software as software that assists HR specialists in the talent acquisition process at any or all of the stages, from sourcing and filtering the potential applicant pool to evaluating a candidate's interview performance with the use of novel techniques such as automated psychometric testing [6]. Our analysis shows that there exist multiple vendors of recruiting software that provide employers with a variety of AI services that can modernise their hiring strategy.

3.1 AI services in recruiting software

In the United States alone, there are over 260 registered startups that utilise AI in recruiting [158]. Figure 1 provides an overview of 25 popular recruiting software vendors and AI services they offer. We further describe these services and how they affect modern recruiting practices.

Vendors	Services						
	CV/profile screening	Diversity hiring	Sourcing	Conversational AI	Video interview screening	Cross-platform insights	Psychometric testing
AmazingHiring[9]	■		■			■	
Arctic Shores[10]							■
Arya by Leoforce[11]	■	■	■				
Checkr[12]						■	
CVViZ[13]	■		■				
Eightfold[14]	■	■	■				
Fetcher[15]		■	■				
Harver[16]	■	■					■
HiredScore[17]	■	■	■				
hireEZ[18]		■	■			■	
HireVue[19]	■	■		■	■		
Humanly[20]	■	■		■	■		
Ideal.[21]		■		■			
Loxo[22]			■				
Mya (acquired by StepStone)[23]				■			
MyInterview[24]					■	■	
Olivia by Paradox[25]	■			■			
pandoIQ by PandoLogic[26]			■	■			
Pymetrics[27]		■					■
SeekOut[28]	■	■	■			■	
Talkpush[29]			■	■		■	
TurboHire[30]	■		■		■		
Vervoe[31]		■		■	■		
XOR[32]	■	■	■	■			
Zoho Recruit[33]	■			■			
count	13	13	13	10	5	6	3

Figure 1: AI services provided by recruiting software vendors

[9] https://amazinghiring.com/
[10] https://www.arcticshores.com/
[11] https://leoforce.com/
[12] https://checkr.com/
[13] https://cvviz.com/
[14] https://eightfold.ai/
[15] https://fetcher.ai/
[16] https://harver.com/
[17] https://www.hiredscore.com/
[18] https://hireez.com/
[19] https://www.hirevue.com/
[20] https://humanly.io/
[21] https://ideal.com/
[22] https://www.loxo.co/
[23] https://www.stepstone.com/en/mya/
[24] https://www.myinterview.com/
[25] https://www.paradox.ai/
[26] https://pandologic.com/
[27] https://www.pymetrics.ai/assessments
[28] https://seekout.com/
[29] https://talkpush.com/
[30] https://turbohire.co/
[31] https://vervoe.com/

Video interview screening. In recent years, asynchronous video interviews (AVI) have become a popular alternative for synchronous video interviews (SVI) as a mean of further standardisation and upscaling the candidate assessment at lower costs and in a shorter time [112]. AVI is a format of a one-way interview, in which a candidate records a video where they answer interview questions, normally in a limited time frame, which a hiring manager can view at a later point in time [155]. Companies like HireVue and MyInterview add AI algorithms to their AVI systems to make this process even more efficient. AI is used to extract candidate's features and expressions from audiovisual files in order to predict their interpersonal skills [23]. Studies show that such algorithms are often able to accurately predict qualities like openness, agreeableness, likeability, and evaluate communication skills [150] [136][22].

CV/profile screening. Although dynamic filtering has become an industry norm for filtering a large number of CVs recruiters receive daily, it has many limitations: it relies on well-formatted resumes of common file type and has trouble matching an ideal candidate profile and skill-set due to its keyword restrictions [141]. A machine learning algorithm can extract information from a candidate's resume of any file type using natural language processing (NLP) techniques, assess them based on predefined criteria or historical data, and finally rank the resumes to present the best candidates to hiring managers in a very short time [120]. CV screening software ranges from simple boolean/keyword search [8] to advanced neural networks [118][143].

Conversational AI. Conversational AI is a software that is able to imitate a natural human-like dialogue in written or spoken form by using natural language understanding (NLU), and natural language generation (NLG) [40] also commonly referred to as a "chatbot". AI chatbots can assist recruiters in many different processes in hiring: gathering information about candidates, answering their questions, filtering and pre-screening the candidates' profiles, scheduling interviews and providing feedback [119]. Conversational AI like Mya and Olivia can appropriately react to candidate's questions and provide them with requested answers, and even engage in more comprehensive conversations for preliminary screening. A clear advantage of AI chatbots in recruiting is their ability to take over time-consuming standardized tasks,

[32]https://www.xor.ai/
[33]https://www.zoho.com/recruit/

thereby allowing a hiring specialist to focus on high cognitive demand tasks with a higher value for the company. Some chatbots can perform an evaluation of personal characteristics and generate a report for a hiring manager, enabling further automation of the employee selection process [20]. An empirical study [144] demonstrated readiness of job seekers to use chatbots to quickly learn general information about the company and its vacancies. However, many respondents also criticised chatbots for impersonal and emotionless communication, as well as problems with understanding more complex contexts, so improving the naturalness of interaction with conversational AI is currently the main focus of the industry [40].

Sourcing. Sourcing encompasses various proactive measures undertaken by recruiters to create a potential applicant pool that can include people new to the labour market (e.g. college and university graduates), experienced employees looking for new opportunities or freelancers ready to support a project in the company [148]. AI tools can assist recruiters in this task by searching through large databases using predefined features and filtering the candidate profiles to find those that best match to the job description among both active and passive job seekers [73]. LinkedIn's Talent Solutions enhances its searching function by offering a service that employs a machine learning algorithm to connect recruiters to the job seekers that will be most interested in their offer [135].

Psychometric testing. Recent research proved well-crafted psychometric tests to be an effective tool for assessment of candidate's cognitive abilities, personality traits, motivation, and future professional performance in a complex work environment, which serves as a good alternative to traditional interview practices [28][10]. Companies like Pymetrics and Arctic Shores claim to revolutionise psychometric assessment by combining AI and gamification trends based on research in the fields of neuroscience and psychology. They train AI algorithms or organisation's top performers to identify key traits to look for in new hires, and then use simple online games to compare the candidates with an "ideal profile" [145].

Cross-platform insights. Some recruiting software vendors (e.g. AmazingHiring[34], Manatal[35]) use AI to enrich the data about candidates to increase sourcing and screening value and accuracy. The essence of this AI application is automation of digital profiling or cybervetting, which many recruiters use in order to *"minimise risks"* and assess *"organisational fit"* [108] [11]. By automatically screening a prospective employee's relevant social media profiles, such algorithms can fill gaps in a candidate's resume and offer more insights for a hiring manage [151]. Moreover, gathering personal data from social media enables AI to analyse applicant's interests, skills, character and other features that could help an algorithm make a more accurate decision [17]. There is strong evidence that social media activity data (Facebook interactions with friends, Twitter postings) can make a valuable contribution to evaluating personality traits [124][51][116].

Cross-platform candidate-related data sourcing also allows for fast and accurate background checks that are a traditional screening step in law enforcement, government offices, finance sector, senior management positions etc. [19][93]. Background checks might include reference checks, criminal records, work history and many other data points, and a thorough investigation process increases the complexity of profile screening for an HR specialist [137]. Seekout[36] and Checkr offer an AI-powered solution for clearance checks to speed up this procedure.

3.2 Adoption of AI recruiting

In spite of the clear benefits of AI in recruiting, the adoption of such software as of now is low. A 2022 report by Phenom [132] revealed that 95% of Fortune 500 companies do not leverage AI recruiting, or do so poorly. The reasons for this lie not in the technical aversion of HR workers. In fact, according to the Harvard Business School report [57], nearly 75% of employers in US and 54% in Germany use Applicant Tracking Software (ATS) to optimise the hiring process. Researchers name a few substantial factors preventing wider adoption of AI recruiting software such as complex and inconvenient applications, lacking understanding of benefits that AI systems provide [2], data security and privacy concerns, and a need for cardinal strategical restructuring of traditional HR processes that are not always supported by upper

[34]https://amazinghiring.com/dataenrichment/
[35]https://www.manatal.com/features/candidate-enrichment
[36]https://seekout.com/solution/cleared-candidates/

management [127][133]. Furthermore, employers and recruiters tend to deem human professionals' decisions more reliable than AI's, especially when it involves subjective judging of skills, which highlights aversion of giving up the traditional methods as a decisive factor preventing AI adoption [89].

Several research papers also investigated job seekers' reactions to AI usage in the recruiting process. One study shows that over 80% of the candidates are cautious about how their personal data is being used and stored during the interaction with a recruiting chatbot [144]. People also believe that automated decision-making struggles from the inability to consider the context of given information due to its cognitive limitations and lack of emotions [68]. There are implications that anxiety and uncertainty resulting from the hidden and unclear application of AI makes a company less attractive for the applicants [162], which poses a risk to a company. Managers and developers must take candidates' and HR specialists' concerns into consideration when designing, integrating and advertising their AI recruiting software to secure a good reputation because applicant's satisfaction with a recruiting process has a significant influence on their likelihood to accept the offer, recommend the employer in their network and general attractiveness of a company [66]. However, these findings do not speak against AI recruiting as a whole. A comprehensive study investigating the concept of fairness in AI [9] showed that people perceive algorithms as objective evaluators that treat everyone equally, but nevertheless prefer a human to make the final decision. Moreover, these studies reveal that distrust in algorithms decreases when recruiters are open about using AI and build trust by providing sufficient explanation and transparency. The positive implications in terms of removing human bias and fatigue influence from assessment, competitive pressure and cost benefits at scale make AI recruiting software worth adopting in the future [133].

3.3 Concerns around AI recruiting

We are able to observe alarming signs of unfair AI decisions in recruiting from investigations performed by researchers and journalists. One case that is often mentioned in the literature revolves around Amazon's CV screening application that favoured men over women while choosing the suitable candidate for the position [30]. The issue arose due to developers using biased input data consisting of resumes from the highly male-dominated IT sphere (back in 2014, when this system was still in use, 63% of Amazon employees

were male, up to 75% in management [104]) and incorporating historic male favouritism into the software. Another study raises alarm about race discrimination in the facial recognition algorithms being trained mostly on the images of white people [18]. An experiment evaluating video interview software demonstrated that attributes as background, accessories (e.g. glasses) as well as audio and video quality might have a significant impact on the automated evaluation, decreasing the value of this form of assessment [165]. These cases demonstrate that AI software often continues historical discrimination in the workplace and struggles to fairly assess candidates due to technically imperfect algorithms. Instead of eliminating human bias from the hiring process, recruiting AI merely automates it. Revealed embedded biases not only expose legal and ethical issues of using AI for hiring, but they also make employers question the reliability of AI recruiting tools that might cause them to overlook real talents that don't fit into the predefined frame of the algorithm and prevent diversification of their personnel. By not addressing the bias incorporated into machine learning algorithms that power recruiting software, we allow for more discrimination in the labour market, preventing historically disadvantaged groups of people from receiving the jobs that match their qualifications [31].

Practice has shown that simple fixes of an algorithm such as eliminating sensitive factors like race and gender from data used for training and decision-making do not deliver an expected result because AI remains prone to causal discrimination [58]. It is enough for an algorithm to pick up a word that is more probable to be present on one group's resumes than the others to make a biased decision. This way, Amazon's recruiting software used to give a lower score to resumes that contained the word "women's" [30]. There are multiple sources for biases in AI algorithms: data collection, data processing, algorithm architecture and software misuse [54]. To address problems that may appear at different stages, AI recruiting programmes must follow ethical principles throughout the entire development process, from requirements engineering to testing and utilisation. We speak of *fairness by design* to mitigate *bias by default* that emerges by not addressing unfairness in training data and software architecture. Fair AI requires actionable discrimination-aware design principles developed in cooperation with machine learning and employment policy-makers [139]. Researchers of AI fairness also argue for the need of introducing external AI audit to prove the absence of harmful influence of algorithms [88], which raises the discussion of increased control of AI in business.

4 Legal and ethical implications of recruiting AI

To begin the discussion about legal and ethical compliance of AI applications, we must first define what it means for AI to be ethical. In this chapter, we thoroughly analyse existing legal regulations and guidelines in order to identify and summarise important principles of ethical AI and thus define this concept.

4.1 Principles of ethical AI

Figure 2 presents the table categorising the principles from different guidelines, frameworks, and regulations into the concepts of ethical AI. We found the principles ensuring data protection and privacy, fairness, explainability, accountability and transparency to be present in most guidelines we analysed. Similar comprehensive evaluations performed by Hagendorff [64] and Health Ethics & Policy Lab from ETH Zurich [83] had these 6 principles as the most frequently occurring in the discussion about ethical AI as well. One principle that encompasses the rest is the *focus on human well-being*, which highlights the role of AI as a helping tool to improve public welfare and prohibits the AI systems to do any harm.

The first ethical AI principle we would like to cover in more detail is *data protection and privacy*. The General Data Protection Regulation (GDPR) [47] defines personal data protection as a fundamental right, and states that its processing must only occur in a way that serves the welfare of mankind. Accurate predictions of complex AI models require a big amount of data, and in the case of recruiting this data can be considered personal and sensitive, which increases the relevance of this principle [86]. To ensure sufficient data protection and privacy, we must address concerns that arise in 4 dimensions of data processing: data acquisition, data usage in analysis, data transfer, and data storage [113].

Another ethical principle tightly linked with data protection is *safety*, and we use this term in relation to the technical *security* of AI systems. AI software can become a target to a broad range of malicious manipulations (e.g. data poisoning, interference with AI functionality, harmful repurposing of

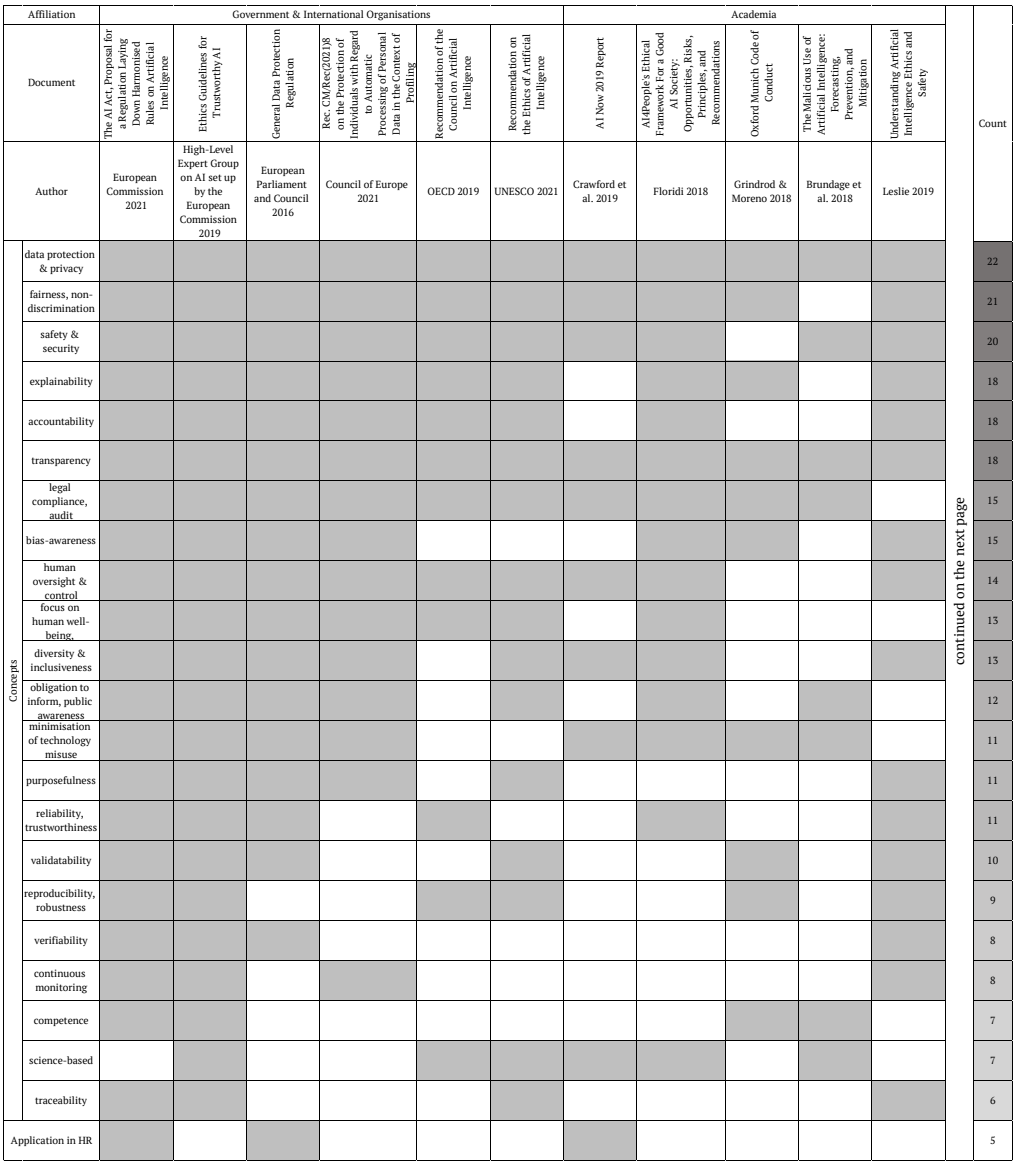

Figure 2: Ethical AI guidelines and concepts they cover

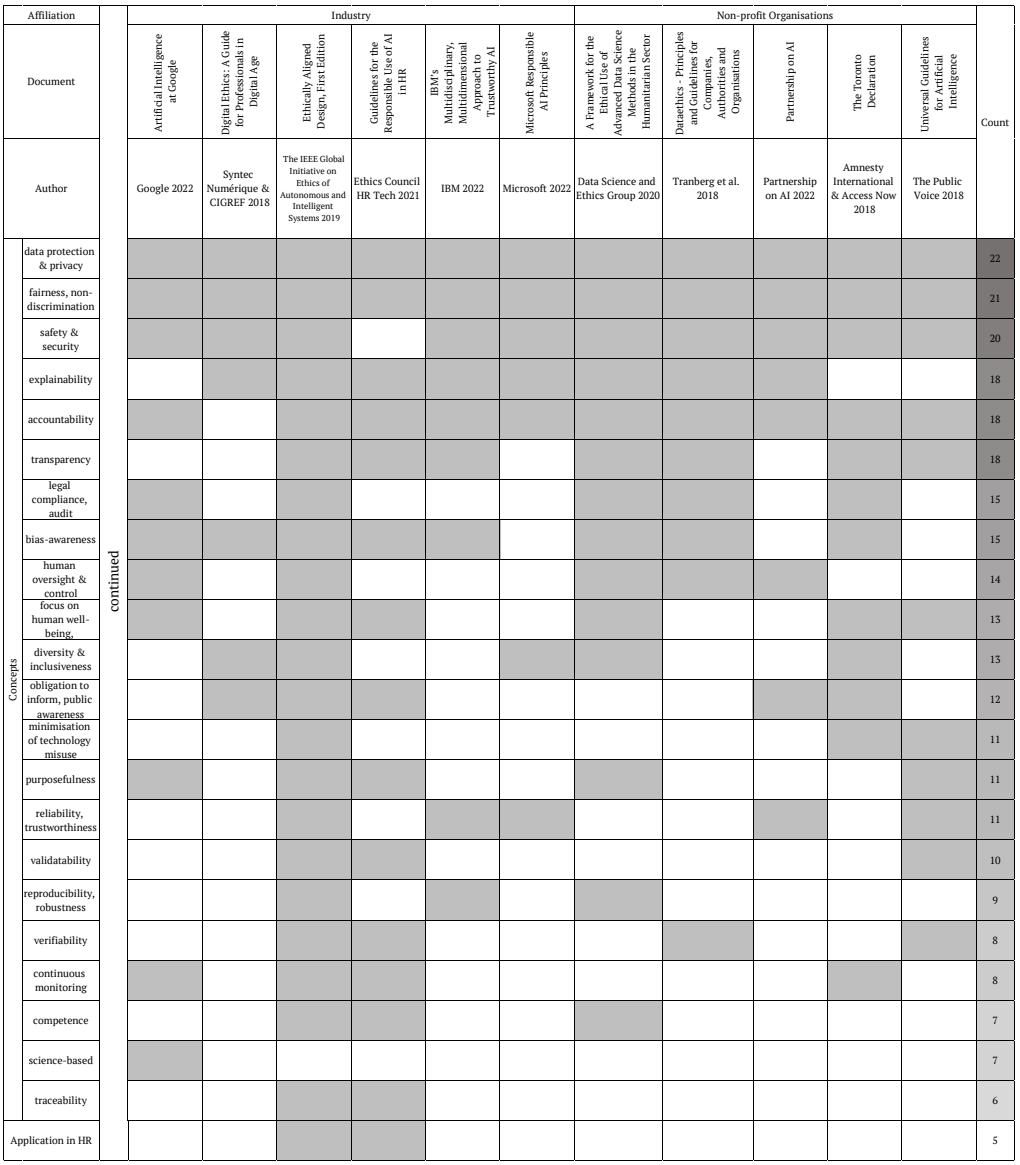

Figure 2 (Cont.): Ethical AI guidelines and concepts they cover

software) [43]. It is necessary to take measures to prevent the exploitation of AI systems, so developing, implementing and maintaining a high-level cybersecurity strategy became a very important element of reliable AI software design [46].

Fairness principle prohibits any direct or indirect discrimination of individuals based on their innate or obtained characteristics such as race, age, marital status, religious beliefs and others [111]. While machine learning algorithms can be a good tool to remove human biases and diversify the team in the context of recruiting [3], unintentional discrimination by proxy poses a serious issue when AI software decides in disfavour of a protected by employment legislation group of people due to seemingly harmless data points like a person's home address [53]. AI algorithms in recruiting must be built to value *diversity* and to facilitate the promotion of equity [106]. To address this issue, many AI recruiting vendors include the concept of "diversity hiring" in their software by design (Figure 1). For example, according to their websites, Eightfold[37] has built-in diversity analytics and uses methods to ensure that only skills-related data is used in the assessment, Fetcher[38] takes action to diversify the candidate pool in bias-free sourcing, and HireVue[39] ensures their interviews are well-structured at the beginning of the assessments to create fair uniform conditions for all candidates.

The *explainability* of AI systems is described in the GDPR as *"meaningful information about the logic involved in [automated decision-making]"* [47]. As such, this principle aims to ensure that all people affected by AI algorithms are able to gain insights into the decision-making process and understand it. The insights obtained from analysing the algorithm can reveal integral algorithmic biases and inefficiencies, and they assist developers in tuning and improving the software and allow users to learn about correlations and trends that lead to AI's conclusion [27]. Establishing the explainability of the system is also very important for permitting external audits to ensure legal compliance [46]. Despite the increasing importance and value of explainable AI, most methods of assessment nowadays are not capable of confidently explaining vigorous AI algorithms, so it remains a major area of research [27][41].

[37]https://eightfold.ai/why-eightfold/diversity-and-inclusion/
[38]https://www.fetcher.ai/features/diversity
[39]https://www.hirevue.com/employment-diversity-bias

Transparency is closely linked to the concept of explainability, as they both contribute to the interpretability of the machine learning model. But rather than delivering the post-hoc explanations of the algorithm's decision, the transparency principle covers a broader range of the model's components from the perspective of human understanding. Lipton [101] defines 3 dimensions of the model's transparency. Firstly, the algorithm as a whole can be contemplated or even replicated by means of human calculations in a reasonable amount of time that is adjusted to consider the limitations of human cognitive performance. Thus, the size of the model is a significant factor for its transparency, and developers should opt for more concise options when it is possible and reasonable. Secondly, the model's input parameters, pre-processing of the data and calculations must be intuitively explainable. Lastly, the behaviour of AI post-training must be predictable with a decent degree of confidence to ensure its effectiveness in its use on new data. An additional dimension to the transparency of AI recruiting lies beyond the algorithm itself and includes the *obligation* of an employer utilising AI recruiting software to *inform* a candidate about the data they process and predictive tools they use [16].

Accountability refers to the ability to hold the users and developers of an AI algorithm responsible in case it has not been designed or used in accordance with the law, and social and ethical standards [87]. Researchers of accountable AI [34] note that the assumption behind light regulation of AI is based on the idea of *human oversight and control* over the system and only supplementary meaning of AI in the decision-making process. They state, however, that the increase in reliance on algorithms as the only decision-maker makes the question of accountability very important for the lawful and ethical use of AI. In connection with a lack of explainability and transparency, there is a rising concern that companies leveraging AI technology might escape responsibility by attributing the potential causes of misuse to vulnerable stakeholders, like data owners that are subjected to the algorithm's decision [97]. Therefore, developers of AI software must bear responsibility to foresee eventual shortcomings and mitigate potential causes of misuse to prevent it from happening in the first place, so we speak of the concept of *forward-looking responsibility* [24].

4.2 Legal AI regulations

The regulatory authorities of the EU recognise the ever-increasing influence of data and AI on the everyday lives of EU citizens and the issues they provoke. In consequence, the European Commission published a comprehensive proposal for the regulation of AI called AI Act [46] with the purpose of creating a *legal framework for trustworthy AI* to increase societal well-being and confidence in AI-based systems as well as encourage businesses in all industries to adopt new technologies and utilise them in effective yet responsible manner. The AI Act is composed in accordance with EU rights and values and aims to clarify legal concerns to facilitate future AI development and ensure its safety and lawfulness. Besides stating the EU values and providing recommendations, this regulation also includes strict penalties for non-compliance (Article 71 of AI Act [46]), which aligns it with the GDPR. Since the AI Act is not expected to become into effect before 2025 [106], the GDPR remains the most relevant regulation for AI systems in the EU that can be indirectly applicable to regulating AI systems at the moment. This function of the GDPR is supported by the 2020 study, acknowledged by the European Parliament [142]. Although the GDPR does not mention the term AI, it contains regulations relevant to *automated decision-making* (Article 22 GDPR [47]) with regard to data protection and human control over the system's functionality and accountability for its output. An extensive regulation of personal data usage can be applied to AI systems in a way that does not hinder the data analysis necessary for machine learning algorithms and does not put European AI developers at a disadvantage compared to their competitors outside the EU [46]. However, further clarifications and explicit regulations are necessary to decrease uncertainty and possible misinterpretations regarding individualised profiling [142], which is the cornerstone of candidate assessment in AI recruiting software. The Council of Europe issued the "Recommendation on the Protection of Individuals with Regard to Automatic Processing of Personal Data in the Context of Profiling" [29], which aims to modernise the Convention 108[40]. Due to the processing of highly personal data that can affect many people and being subject to legal regulations, AI profiling performed by candidate selection software can be classified as *high-risk profiling.* The Council's Recommendation calls for strict measures for assessment, documenting and monitoring high-risk AI systems as well as penalising misuse of them regardless of the size of the enterprise and affected group. The AI Act explicitly classifies AI recruiting

[40]Convention for the Protection of Individuals with regard to Automatic Processing of Personal Data of 28 January 1981

systems as high-risk due to their impact on the careers and lives of people. It also raises awareness about data protection and privacy, as well as discrimination of historically disadvantaged in groups of people in employment [46]. The European Commission demands that the data used for validation and training of high-risk AI models is of high quality, meaning it is relevant, representative, and error-free.

AI recruiting software must also comply with legal policies regarding traditional hiring practices. However, it is difficult to detect violations due to non-transparent algorithms and businesses not willing to disclose the details of their functionality, since AI itself, the training data and the outcomes are all subjects to copyright and are often protected by patents [59]. Therefore, providing a sufficient level of algorithmic transparency also becomes a legal obligation of companies developing and operating recruiting AI software under the AI Act [46]. Similarly, Article 88 of the GDPR [47] emphasises the relevance of transparency regulations in the context of employment and recruiting in particular.

In summary, regulators [47][46][45][29] call for

1. respect of fundamental human rights and compliance with existing regulations in the EU, especially those of non-discrimination and privacy,
2. sufficient explainability and bias-awareness by means of clear relevant documentation and risk assessment of AI software,
3. duty to inform owners of the data about the fact and purpose of data processing and guarantee of GDPR-compliant procedure that is sufficiently secure and robust,
4. clear statement of purpose of an AI algorithm and its relevance to the achievement of company's goals,
5. transparency and accessibility of (high-risk) AI software to regulators for regular compliance audits and certifications,
6. accountability for enterprises employing (high-risk) AI software and penalties in a case of malicious use/misuse of data or AI algorithms that endangers the human rights.

Legal documents [29][47][46] also mention the obligation of AI developers to obtain certifications that prove their software's compliance with described

ethical and safety requirements before it is allowed to be used in business operations. Following Article 25 of the GDPR [47], the ethical AI principles defending human rights and values must be implemented in the AI software *by design and by default.*

5 Framework for evaluating AI recruiting software

As demonstrated in Figure 2, there exist detailed guidelines for ethical AI, which cover a variety of concepts and rules. However, they tend to be vague and impractical, which prevents AI developers from accurately applying these principles of in practice [37]. Therefore, industry experts, researchers and governmental organisations create more applied frameworks to assist in implementing the principles of ethical AI in real-world applications. The European Commission published a guidebook *"Assessment List for Trustworthy Artificial Intelligence (ALTAI) for self-assessment"* [45] in order to facilitate the self-evaluation of AI in organisations. Another useful framework *"People + AI Guidebook"* [131] is maintained by Google, and it provides more technical action points and examples. There are also more detailed step-by-step frameworks with direct recommendations, like the *"HHS Trustworthy AI Playbook"* [167]. Although these frameworks cover most of the points detected in our guidelines overview, they do not focus on any particular application of AI and are more general. During our literature review, we discovered considerable discussion regarding AI algorithms in recruiting, the perspectives on bias and fairness, as well as related trust issues and expectations of the workers, which we have reflected in our thesis so far. However, we did not observe a significant amount of studies that provided direct recommendations for the implementation of AI algorithms in recruiting. One framework with such focus was published by an AI recruiting software vendor Sapia [82], though it also does not specify many action points a developer could rely on.

5.1 The goal of the framework

The lack of actionable guidelines for the development and evaluation of AI recruiting algorithms motivates us to accumulate the knowledge of other researchers of fair AI and modern recruiting strategies in order to compose our

own framework to assist with this matter. We identify the most important principles of ethical AI and analyse the steps of a general recruiting process to create a guide for engineers and users to follow during the development, evaluation, and utilisation of AI recruiting software. Besides clearly defined activities, we also provide sources of legal documentation to further support and clarify the requirements. In order to deliver as much practical value as possible for a multipurpose framework, we include tools and recommendations the users of the framework may consider while following the steps. Thus, the goal of our framework is to summarise the findings of our research and assist employers in their course of adoption of AI recruiting software by offering clear practical recommendations

5.2 Recruiting process

In order to provide sound recommendations regarding AI recruiting software integration, we started by first analysing instances of modern recruiting processes. A general process derived from the studied literature is presented in Figure 3. It includes usual stages and activities of the recruiting process, adapted to reflect trends in e-recruitment [74][163][16]. Our analysis of services offered by AI recruiting software vendors (Figure 1) corresponds to a depicted recruiting process and supported outlined stages and activities, which illustrates the range of opportunities for automatisation with already existing tools.

In the first stage, the specifications and requirements for a job are analysed and the desired candidate profile is created. For evaluating defined requirements such as level of education, qualifications, technical and organisation fit, suitable selection criteria and methods are determined [163]. Subsequently, a recruiting specialist identifies potential channels for job advertisements to target qualified applicants. This process can be optimised with the help of AI sourcing software. Submitted applications are recorded, pre-screened and filtered to create a candidate pool for further evaluation. Cross-platform insight collected from different sources by AI agent enrich candidate profile and assist with pre-screening. In the next step, candidates are invited to take part in an assessment event, where their skills and motivation are analysed by an HR specialist and/or representatives of the hiring department. Such assessments can be held in a format of on-site or digital interviews, traditional assessment centres (e.g. case study, code interview), psychometric tests etc. [140]. These processes can be covered by a variety of recruiting AI services

such as AI-enhanced CV screening, video interview screening and psychometric testing. Lastly, applicant performances are ranked, and a recruiter makes a hiring decision and communicates it with accepted and rejected candidates. This activity is very important for the company's image, as discussed in chapter 3, and AI chatbots can optimise it by generating valuable feedback for the candidates from the recruiter's documented insights.

Stage	Activities
Identify requirements	Develop a job spcecification, analyse job requirements and ideal candidate profile
Attract applicants	Optimise job posting outreach by selecting optimal recruiting channels and advertisement strategy
	Inform and engage with potential applicants, maintain career website
	Automate sourcing of candidates matching the profile
Process incoming applications	Pre-screen, sort and filter applications to create a candidate pool
Screen applicants	Analyse and compare candidates' profiles based on resumes, written assessments, short first interviews
	Perform reference and clearance checks, profiling
Assess and select candidates	Assess applicants by conducting on-site or video interviews, written hard and soft skills assessments
	Rank candidates based on their qualifications and organisational fit
Provide feedback	Notify selected candidates and provide information regarding onboarding
	Notify rejected candidates and provide helpful feedback

Figure 3: Recruiting process

5.3 Defining core principles of ethical AI

After having established general principles and concepts of ethical AI in chapter 4, we now specify them to be applicable to AI usage in the recruiting process as we demonstrated it earlier. These definitions serve as a foundation for our framework and explain the purpose of activities proposed in it. We encourage users of the framework to further research the following principles to increase the quality of their ethical AI implementation.

Data protection & privacy. The GDPR specifies legally binding rules regarding the processing of personal data. Personal data is defined as *"any information relating to an identified or identifiable natural person"* [47], meaning that AI recruiting applications are unavoidably affected by the GDPR due to their purpose of directly assessing and ranking natural persons by processing their personal data. Article 5 of the GDPR specifies principles related to processing of personal data which include *transparency*, *purpose limitation*, *integrity and confidentiality*, and *data minimisation*. Another important principle that we summarised under data protection & privacy principle is the *duty to inform*, which states that employers that use AI recruiting software must disclose this fact to the candidates, and provide a complete list of personal data they gather and how they intend to process it [47]. This measure gives a candidate an opportunity to make an informed decision when granting consent for the usage of their personal data. Additionally, candidates must be able to revoke their consent for processing or storing their personal data at any time, and the employer is obliged to satisfy this request according to the GDPR [47]. All mentioned principles and requirements are considered in our framework and supported by actionable steps to ensure GDPR compliance. In order to guarantee sufficient *privacy* of sensitive candidate data, we advise undertaking measures such as differential privacy [35], usage of synthetic data [1] or comparable procedures. Moreover, we recommend following the official GDPR compliance checklist[41] for even more concrete guidance.

Purposefulness. It is important to mention that AI recruiting software may not collect more personal data than it is necessary for the direct purpose of candidate assessment (*data minimisation* and *purpose limitation* principles

[41] https://gdpr.eu/checklist/

of the GDPR [47]), or conduct out-of-scope analysis that does not serve a pre-specified and disclosed goal. The primary objective of the AI recruiting software is to assist recruiting specialists in the talent acquisition process, and it must be guaranteed that the candidate data or the results of its processing will not be used anywhere other than for this intended purpose.

Fairness. Due to the moral and legal obligation of employers to treat all candidates in a fair and non-discriminatory manner in the course of the recruiting process, fairness becomes the cornerstone of ethical recruiting AI evaluation. Discrimination with regard to gender, race, ethnic and social origin, genetic features, religious and political beliefs, disabilities, age or sexual orientation is prohibited in the EU [48], and this principle must be strictly respected in the hiring process. An exceptional effort needs to be put into prohibiting AI recruiting applications to enhance historical bias that occurs in imperfect training data during algorithm development, and can significantly distort the results if it remains unaccounted for [111].

Diversity and inclusiveness. Following the previously mentioned fairness principle, it is important to ensure that the AI recruiting algorithm is tailored to process a diverse pool of candidates without discriminatory tendencies and to foster diversity in the recruiting process [106]. The direction for more diversity and inclusiveness must be embedded into the hiring culture of the company, and subsequently reflected in the AI recruiting tools it uses. Thus, the diversity and inclusiveness principle must be prioritised on the strategic level and considered from the early stages of the AI integration process.

Safety & security. Any AI application that deals with big amounts of sensitive personal data must be secured following state-of-the-art cybersecurity standards on all stages of data collection, transfer, processing, and storage. Therefore, designers of AI recruiting software must undertake measures to prevent intended or unintended misuse and malicious manipulation of data and AI algorithms. The GDPR calls for a reasonable combination of technical and organisational measures in order to achieve *integrity* and *confidentiality* in operations with personal data [47].

Explainability. Due to the high-risk classification of AI recruiting software by the AI Act [46], there must exist comprehensive documentation and a mechanism for gaining clear insights into the algorithm's functionality and output. An important step in explainable AI development is the presentation of the factors that led to the results presented by the algorithm, which would allow a recruiting specialist to analyse the soundness of this decision. For example, a good CV screening system would summarise and visualise the influential factors and their importance for the hiring decision, and then allow a hiring manager to evaluate the output and confirm or reject it, thus offering them a feedback opportunity for further improvement of the algorithm [16].

Accountability. Employers that use AI algorithms during the recruiting process must be held accountable for unlawful procedures and must bear the same legal consequences as those engaged in traditional analogue recruiting practices. Therefore, it is necessary to ensure *traceability* of the digital recruiting involving AI recruiting software, and define areas of *responsibility* for all parties involved in the process. Ensuring a sufficient degree of human *oversight and control* is requisite in order to prevent ambiguity in responsibility distribution in a case of illicit or unfair hiring decision because responsibility before the law cannot be shifted towards the AI. This principle must also serve as motivation for AI developers to adhere to legal and ethical guidelines in the course of software development.

Transparency. The transparency principle states that the algorithm must be sufficiently clear and interpretable for its users and external auditors [101]. It includes activities to ensure explainability and accountability, and relies on extensive documentation and ethical design culture. In our framework, we expand this definition of transparency to cover the entire recruiting process, meaning it is also applied to the non-technical supportive and decision-making activities. Thus, the transparency principle is a crucial element to prevent discriminatory practices and allow to perform the assessment of the AI recruiting process in the first place.

Legal compliance. The principle of legal compliance, also often referred to as *lawfulness*, is the requirement for any AI software to be utilised on the territory affected by AI and data protection regulations. Employers aiming to adopt AI recruiting software must ensure its compliance with universal (i.e.

Universal Declaration of Human Rights [160]), supranational (i.e. GDPR [47]), national (i.e. national non-discrimination and employment laws), and other binding legal acts.

Human oversight & control. Despite the benefits of automation of certain stages of the recruiting process, making a hiring decision remains a composite and personal task. In chapter 3 we discussed issues and concerns around AI adoption in recruiting and discovered that human judgement and control over the decision increases perceived reliability and fairness. Moreover, human oversight is required by the AI Act [46] on the grounds that candidates must be protected from the erroneous output of the algorithm as much as it is feasible to guarantee. This principle highlights the role of AI algorithms in recruiting as advisers, but not as a replacement for a recruiting specialist when it comes to making the hiring decision.

Competence. Both developers and users must possess sufficient expertise in their respective tasks to correctly develop and utilise AI recruiting software in accordance with legal and ethical guidelines. Our framework stimulates implementing principles of ethical AI in software by design. We especially encourage extensive training of recruiting specialists to allow them to properly interpret and apply the output of AI algorithms during the recruiting process. The AI Act endorses informing all involved stakeholders about the intended use and functionality of high-risk AI systems by providing detailed instructions [46]. As the necessary technical expertise is unlikely to exist within the traditional HR department, close collaboration with vendors and/or technical specialists within the company may help to bridge the knowledge gap between AI and recruiting specialists. We recommend organising workshops and product demonstrations, as well as providing recruiters with other resources about AI recruiting software in use to enable them to acquire the necessary skills and expertise.

Focus on human well-being. The final concept we define is the focus on human well-being, which expresses the whole motivation for ethical assessment and legal regulations. The GDPR and the AI Act [47][46] highlight this principle as the central purpose of AI software. AI recruiting applications are obliged to *serve humanity* and are prohibited to endanger fundamental human rights.

5.4 Framework for ethical AI in recruiting

Figure 4 presents the framework for evaluation of AI recruiting applications in accordance with legal regulations concerning AI and data protection in the EU, as well as guidelines aiming to ensure the non-discriminatory and safe usage of AI software. We divide our framework into 4 stages that correspond to the general stages of software development and integration in business environment: *problem analysis*, *data*-related operations, *algorithm* development and system *output* usage. These stages are further subdivided into processes that roughly define the processes relevant for every stage. Within these processes, we define activities we recommend performing to ensure ethical and legal compliance of AI in recruiting. Additionally, we complement all 67 activities with legal acts to demonstrate binding requisitions. It is important to note that the AI Act is not a legally binding act when we write this thesis and may be updated in the future. However, we still find it to be a valuable source to set expectations for future regulations. Furthermore, we advise that AI practitioners consider the tools and recommendations we provide alongside the activities for practical guidelines. These tools were selected in a process of literature review of comparative studies and expert recommendations with a focus on practicality and usability. The sources and references for the selected tools and recommendations (where applicable) are presented in Appendix B. Lastly, we indicate which principles are represented by demonstrated activities, which serves as guidance for both understanding the definition of ethical AI and assistance in altering the proposed framework to match specific scenarios a user may encounter. Depending on the use case (AI recruiting software purchase, development, integration etc.) different activities might be applicable since the framework is intentionally kept broad and generalised to be useful in different applications.

Activities	Relevant principles	Legal regulations	Tools & Recommendations
1. Problem analysis			
Preparational activities for development/purchase/integration of AI recruiting software			
1.1. Problem definition			
1.1.1. Analyse the business opportunities and value of the AI recruiting technology for the stakeholders	Purposefulness, focus on human well-being		Stakeholder needs analysis and other business analysis techniques
1.1.2. Define roles and responsibilities for stages of the process of problem analysis, development/purchase/integration of software and its evaluation	Competence	GDPR Section 4	Introduce roles of Data Protection Officer, AI ethics committee
1.1.3. Analyse requirements for the open positions at the company (hard skills, soft skills organisation fit etc.)	Explainability		Employee observation, job analysis questionnaire
1.1.4. Establish clear and reasonable selection criteria for each of the open positions	Explainability, fairness, diversity & inclusiveness		Choose appropriate criteria based on the results of job analysis questionnaires
1.1.5. Develop a fair hiring strategy that prioritises diversity and inclusiveness	Diversity & inclusiveness	CRPD, EU Charter of Fundamental Rights	Equal Employment Opportunity checklist, selection of inclusive assessment tools
1.1.6. Generate an inclusive job advertisements and communicate the hiring strategy to the stakeholders	Fairness, diversity & inclusiveness	CRPD, EU Charter of Fundamental Rights	Textio, Diversifier by Witty Works
1.2. Requirements analysis for the solution			
1.2.1. Analyse benefits and issues of AI solution for all involved stakeholders	Focus on human well-being		Cost-benefit analysis, value-added analysis, other decision-making frameworks
1.2.2. Analyse how AI can improve established hiring strategy and obtain empirical evidence for its effectiveness by creating a prototype or requesting trustworthy test results from a vendor	Purposefulness	AI Act Article 19	Business analysis techniques, testimonials, research
1.2.3. Consider existing AI solutions that fulfil the purpose that comply with legal and ethical requirements	Legal compliance, focus on human well-being	AI Act Article 16	Software selection framework
1.2.4. Compare possible AI solutions and decide between development and purchase of complete AI recruiting software or integration in the existing system	Purposefulness		Build vs. buy decision framework
1.2.5. Consult recruiters and AI developers about details of implementation to obtain a multiperspective view	Competence, human oversight &control		Questionnaires, interviews with recruiters
1.2.6. Create thorough methodology for development or integration of AI algorithm and communicate it with all involved parties	Competence, human oversight	AI Act Article 14	People + AI Guidebook
1.3. Risk assessment and compliance with legal and ethical guidelines			
1.3.1. Research legal and ethical regulations applicable for the chosen AI recruiting solution and be mindful of regional differences	Legal compliance, focus on human well-being	GDPR Articles 3, 50, AI Act Article 16	EUR-Lex, AI Ethics Guidelines Global Inventory by Algorithm Watch
1.3.2. Analyse potential harms of AI and which benefits may be sacrificed to mitigate these harms	Fairness	AI Act Articles 7, 9	Tensorflow Responsible AI toolkit
1.3.3. Analyse potential sources of bias that may emerge at any stage of the recruiting process (AI recruiting software usage) or software development	Fairness	AI Act Article 10, CM/Rec(2021)8 Article 3	Apply findings from the previous steps to the recruiting process
1.3.4. Develop an ethical code of conduct for AI recruiting software development and utilisation	Fairness, transparency, focus on human well-being	GDPR Article 40, AI Act Article 17	People + AI Guidebook
continued on the next page			

Figure 4: Framework for ethical AI in recruiting

continued			
Activities	**Relevant principles**	**Legal regulations**	**Tools & Recommendations**
2. Data			
Activities related to obtaining and utilising candidate data in the AI recruitment process for training and testing AI algorithms, as well as evaluating their outputs			
2.1. Data collection			
2.1.1. Collect candidate data representative of the target population for training and testing the AI algorithm	Fairness, diversity & inclusiveness	AI Act Article 10, CM/Rec(2021)8 Article 7	Check for underrepresented groups and consider reweighting or oversampling
2.1.2. Collect only high-quality data that is least affected by the historical, selection and other types of innate biases	Fairness, diversity & inclusiveness,	AI Act Articles 2-5, 10, CM/Rec(2021)8 Article 3	Data quality dashboard
2.1.3. Inform candidates about the purpose, logic and scope of data collection, processing and usage and obtain their explicit consent	Data protection & privacy	GDPR Articles 6, 7, 13, CM/Rec(2021)8 Article 3,4	Consent form with explicit list of gathered data and its intended usage
2.1.4. Minimise the amount of sensitive data gathered only to the relevant and necessary	Data protection & privacy, purposefulness	GDPR Articles 5, 9, 25, CM/Rec(2021)8 Article 3,7	Data protection impact assessment
2.1.5. Ensure GDPR compliance of data collection methods	Data protection & privacy, safety & security, legal compliance	GDPR Articles 16-20	GDPR checklist
2.2. Data transfer			
2.2.1. Ensure secure transmission of personal data	Data protection & privacy, safety & security	GDPR Article 32	Differential privacy (OpenDP), zero knowledge proofs (ZKProof), synthetic data (MostlyAI)
2.2.2. Establish strict control system over transfer of sensitive data to prevent data leaks and malicious transformations	Data protection & privacy, safety & security	AI Act Article 10	Security and privacy controls guidelines by NIST
2.2.3. Ensure GDPR compliance of data transfer methods	Data protection & privacy, safety & security, legal compliance	GDPR Chapter V	GDPR checklist
2.3. Data processing			
2.3.1. Transform the data to comply with relevant ethical and legal regulations and be appropriate for the AI algorithm that is being developed	Legal compliance, data protection & privacy, fairness	GDPR Article 5, AI Act Article 10	Differential privacy (OpenDP), synthetic data (MostlyAI), TensorFlow Responsible AI toolkit
2.3.2. Validate that the data is of sufficient size and quality for training and testing of the AI algorithm	Data protection & privacy	AI Act Article 10	TensorFlow Responsible AI toolkit
2.3.3. Remove features that might lead to discrimination of protected groups of candidates due to historical bias	Fairness	CM/Rec(2021)8 Article	TensorFlow Responsible AI toolkit, Audit AI
2.3.4. Remove connections between data used for candidate assessment (e.g. skills, education) and personal information about the candidate (e.g. name, gender)	Data protection & privacy, fairness	GDPR Articles 25, 32, CM/Rec(2021)8 Article 3	Differential privacy (OpenDP), synthetic data (MostlyAI)
2.3.5. Ensure GDPR compliance of data processing methods	Data protection & privacy, safety & security, legal compliance	GDPR Article 6	GDPR checklist
2.4. Data storage			
2.4.1. Establish secure storage for candidate data	Data protection & privacy, safety & security	GDPR Article 32, CM/Rec(2021)8 Article 7	Cyber Security Framework by NIST
2.4.2. Maintain access permission and prohibit unauthorised access to the data storage	Data protection & privacy, safety & security	GDPR Article 32	Cyber Security Framework by NIST
2.4.3. Maintain stored data in accordance with candidate right to control their personal data and remove data as soon as it had fulfilled its purpose in assessment	Data protection & privacy, safety & security, legal compliance	GDPR Articles 13, 17, CM/Rec(2021)8 Article 4	Request form for restriction of data processing and storage
2.4.4. Enable candidates to obtain information about their personal data or request the deletion of it	Data protection & privacy, legal compliance	GDPR Articles 7, 12-15, AI Act Article 13, CM/Rec(2021)8 Article 5	Request form for restriction of data processing and storage
2.4.5. Ensure GDPR compliance of data storage methods	Data protection & privacy, safety & security, legal compliance	GDPR Article 6	GDPR checklist
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Figure 4 (Cont.): Framework for ethical AI in recruiting

continued			
Activities	**Relevant principles**	**Legal regulations**	**Tools & Recommendations**
3. Algorithm			
Activities related to development, testing and quality assurance of the AI algorithm			
3.1. Training			
3.1.1. Identify clear performance indicators for the machine learning model that match the purpose (e.g. assessment of personality traits vs assessment of technical skills)	Purposefulness	AI Act Article 15	Strictly depends on the algorithm in question and requires separate research
3.1.2. Only consider data that directly serves the previously defined purpose	Purposefulness	GDPR Article 5, CM/Rec(2021)8 Article 7	Know Your Data
3.1.3. Design an algorithm that is averse to enhancing historical bias	Fairness	AI Act Article 15	TensorFlow Responsible AI toolkit
3.1.4. Design a transparent algorithm with clear structure and functionality that a recruiting specialist would understand	Transparency, explainability	GDPR Article 88, AI Act Article 13	InterpretML
3.1.5. Use rule-based or supervised learning algorithms for important decision-making processes	Transparency, explainability	AI Act Articles 13, 14	
3.2. Testing			
3.2.1. Select the most appropriate metric to evaluate the performance of the model	Purposefulness	AI Act Article 15	AI Fairness 360, Fairlearn.
3.2.2. Consider trade-offs between performance metrics and fairness	Purposefulness, fairness	AI Act Article 15	Refine success criteria with ethical considerations
3.2.3. Achieve optimal level of the chosen performance metric	Purposefulness, fairness	AI Act Article 15, CM/Rec(2021)8 Article 7	AIBench
3.2.4. Test for fairness using candidate profiles that differ only in protected characteristics - the algorithm must deliver the same score/decision	Fairness	AI Act Article 15	AI Fairness 360, Fairlearn, Audit AI, TensorFlow Responsible AI toolkit, InterpretML
3.2.5. Perform sufficient amount of user tests and scenarios to ensure consistent behaviour of the algorithm	Explainability, transparency	AI Act Article 15, CM/Rec(2021)8 Article 7	V&V testing
3.2.6. Present results of the model in a clear and explainable manner that recruiting specialists can understand and compare	Explainability, transparency	AI Act Article 14, CM/Rec(2021)8 Article 5	Design practices for explainable AI
3.3. Review			
3.3.1. Review edge cases/low confidence cases and determine whether system's imperfections significantly affect the general performance of the model in terms of practical value and fairness	Fairness, explainability, transparency	AI Act Article 15	AI Fairness 360, Fairlearn, Audit AI, TensorFlow Responsible AI toolkit, InterpretML
3.3.2. Perform independent audit of the entire AI recruiting software to ensure ethical and legal compliance	Legal compliance, fairness	GDPR Article 35, CM/Rec(2021)8 Article 7, AI Act Article 19	Guidelines for AI recruiting audit
3.3.3. Properly document the functionality and expected behaviour of the AI system alongside test results	Transparency, explainability, human oversight & control	GDPR Article 30, AI Act Articles 11, 18, CM/Rec(2021)8 Article 7	Technical documentation
3.4. Monitoring and maintenance			
3.4.1. Implement logging to record algorithm's decisions with all relevant steps to ensure transparency, traceability and explainability	Transparency, explainability, accountability	AI Act Articles 12, 20	Traceable AI tools
3.4.2. Establish thorough pre-release monitoring to ensure that AI's test behaviour matches expected behaviour	Transparency, explainability, human oversight & control	AI Act Article 15, CM/Rec(2021)8 Article 7	Model Cards (MCT), Azure Monitor
3.4.3. Introduce continuous post-release monitoring to ensure that AI's real-world behaviour matches expected behaviour	Transparency, explainability, human oversight & control	AI Act Article 15, CM/Rec(2021)8 Article 7	Model Cards (MCT), Azure Monitor
3.4.4. Use stakeholders' feedback to improve algorithm's technical performance, as well as explainability of its results and other relevant fairness metrics	Competence, human oversight & control	AI Act Article 15	Agile software development techniques, People + AI Guidebook
3.4.5. Identify and mitigate vulnerabilities to prevent external malicious influence	Safety & security	AI Act Article 15	Cyber Security Framework
3.4.6. Enable functionalities that prevent misuse of the system by its users	Safety & security	AI Act Article 15	Cyber Security Framework
3.4.7. Enable rollback, warnings and other functionalities that allow developers to promptly react to security threats	Safety & security	AI Act Article 15	Cyber Security Framework
continued on the next page			

Figure 4 (Cont.): Framework for ethical AI in recruiting

continued			
Activities	**Relevant principles**	**Legal regulations**	**Tools & Recommendations**
4. Output			
Activities related to usage of AI system's output in the recruiting process			
4.1. Education			
4.1.1. Educate involved stakeholders on the purpose, logic and operation of AI recruiting software	Competence	AI Act Article 13	Workshops (e.g. People + AI workshops guide), publications on the company's website
4.1.2. Provide comprehensive training on working with AI algorithm's outputs to recruiting specialists	Competence, human oversight & control	AI Act Article 13	Workshops
4.2. Control			
4.2.1. Ensure traceability of the hiring decision in the recruiting entire process to correctly assign responsibilities	Accountability	GDPR Article 5, AI Act Article 14, CM/Rec(2021)8 Article 5	Documentation, process maps and flowcharts (Lucidchart)
4.2.2. Ensure that a recruiting specialist controls the process of decision making and is able intervene and evaluate performance of AI on any stage	Accountability, human oversight & control	GDPR Article 22, AI Act Article 14	
4.2.3. Ensure that the final hiring decision is met by a recruiting specialist even when other parts of the recruiting process are fully automated	Accountability, human oversight & control	GDPR Article 22, AI Act Article 14	
4.3. Evaluation and improvement			
4.3.1. Ensure that the algorithm's outputs are sufficiently explainable and chosen candidates have clear advantages over the others	Explainability, transparency, fairness	AI Act Article 14	DARPA's Explainable Artificial Intelligence (XAI) Program
4.3.2. Prioritise automatisation on the earlier stages of the recruiting process and increase the level of human control with increased importance of the recruiting activity for the hiring decision	Human oversight & control, accountability	AI Act Article 14	
4.3.3. Introduce positive feedback loop to continuously improve the system. Be mindful of overfitting and enhancing discriminatory trends that emerge due to technical imperfections or biased recruiter's decisions	Human oversight & control, fairness, explainability	AI Act Articles 15, 17	People + AI Guidebook
4.3.4. Record false or unexplainable decisions and share them with developers to improve algorithm's performance	Human oversight & control, explainability	AI Act Article 14	People + AI Guidebook
4.3.5. Analyse and visualise recruiting data to analyse recruiting process. Quantify the results of the changes due to introduction/improvement of the AI recruiting software	Explainability, transparency	AI Act Article 17	Dashboarding and reporting tools (MS PowerBI, Tableau, Zoho)
4.3.6. Regularly analyse performance of AI recruiting software and the recruiting specialist's interaction with it to determine areas of improvement	Explainability, transparency	AI Act Article 14	Agile software development techniques
4.3.7. Monitor new research, legal and ethical regulations regarding AI recruiting and update the software to ensure compliance and improve performance	Legal compliance, competence, human oversight & control	AI Act Article 17	AlgorithmWatch

Figure 4 (Cont.): Framework for ethical AI in recruiting

5.5 Case studies

To demonstrate the usability of our proposed framework for ethical AI recruiting software, we applied it to 4 selected research prototypes of AI recruiting tools [85][146][84][90]. The functionalities of these AI recruiting tools are documented in the research papers by their authors, and we rely on their descriptions in our evaluation. The tools were selected to reflect a range of use cases typically found in the recruiting process. Since access to the full source code of selected prototypes is restricted, this evaluation of use cases focuses on the described methodologies rather than the exact algorithms. We must note that these papers have technical aspects of the algorithms as their main focus, so certain parts of the framework could not be analysed.

Video interview screening. The AI video interviewing tool proposed by Kaya et al. [85] is used to predict a personality profile from recorded videos. The algorithm uses this profile to make a decision on whether to invite the applicant to further recruiting stages or not. The developers specify that they put particular effort into making the output of their tool transparent and explainable for a recruiting specialist in charge of the process by specifying which combination of personality traits led to the decision. The rule-based approach (a decision tree) used by Kaya et al. for ranking personality profiles has the benefit of being transparent and comprehensible for recruiting specialists. However, the personality detection algorithm is a neural network, which is not a transparent approach. Our framework emphasizes the fact that the primary focus of AI recruiting tools is valuable assistance in the decision-making process rather than complete automation, and insights provided by this prototype appear to be sufficiently explainable. From this perspective, the tool would be compliant with our proposed framework in some categories, as indicated in Figure 5, although further tests are necessary to ensure fairness and inclusiveness of such an algorithm.

CV screening. For evaluation of AI recruiting software that focuses on CV screening, we selected two following algorithms: PROSPECT designed by Singh et al. [146], and the Interpretable Person-Job Fit (IPJF) model developed by Le et al. [90]. They are used to extract information from an applicant's resume and match it to the job requirements, either through automatic matching with the job description or through additional specifications by recruiters. The PROSPECT's primary focus is on extracting informa-

			1.1 Problem definition						1.2. Requirements analysis for the solution						1.3. Risk assessment and compliance			
Activities	1. Problem Analysis		1.1.1.	1.1.2.	1.1.3.	1.1.4.	1.1.5.	1.1.6.	1.2.1.	1.2.2.	1.2.3.	1.2.4.	1.2.5.	1.2.6.	1.3.1.	1.3.2.	1.3.3.	1.3.4.
Sources	Service	Author																
	Video Interviewing	Kaya et al.								■								
	CV Screening	Singh et al.			■	■				■								
	Interview Chatbot	Siswanto et al.	■		■				■	■								
	CV Screening	Le et al.	■		■	■			■	■								

			2.1. Data collection					2.2. Data transfer			2.3. Data processing					2.4. Data storage				
Activities	2. Data		2.1.1.	2.1.2.	2.1.3.	2.1.4.	2.1.5.	2.2.1.	2.2.2.	2.2.3.	2.3.1.	2.3.2.	2.3.3.	2.3.4.	2.3.5.	2.4.1.	2.4.2.	2.4.3.	2.4.4.	2.4.5.
Sources	Service	Author																		
	Video Interviewing	Kaya et al.	■	■		■						■	■	■						
	CV Screening	Singh et al.	■			■						■		■						
	Interview Chatbot	Siswanto et al.	■		■	■						■	■	■						
	CV Screening	Le et al.	■			■						■		■						

			3.1. Training					3.2. Testing						3.3. Review			3.4. Monitoring						
Activities	3. Algorithm		3.1.1.	3.1.2.	3.1.3.	3.1.4.	3.1.5.	3.2.1.	3.2.2.	3.2.3.	3.2.4.	3.2.5.	3.2.6.	3.3.1.	3.3.2.	3.3.3.	3.4.1.	3.4.2.	3.4.3.	3.4.4.	3.4.5.	3.4.6.	3.4.7.
Sources	Service	Author																					
	Video Interviewing	Kaya et al.	■	■		■	■	■		■		■	■			■		■					
	CV Screening	Singh et al.	■	■	■	■	■	■		■		■	■			■		■		■			
	Interview Chatbot	Siswanto et al.	■	■		■	■	■		■		■	■			■		■		■			
	CV Screening	Le et al.	■	■	■		■	■		■		■	■			■	■	■					

			4.1. Education		4.2. Control			4.3. Evaluation and improvement						
Activities	4. Output		4.1.1.	4.1.2.	4.2.1.	4.2.2.	4.2.3.	4.3.1.	4.3.2.	4.3.3.	4.3.4.	4.3.5.	4.3.6.	4.3.7.
Sources	Service	Author												
	Video Interviewing	Kaya et al.			■			■						
	CV Screening	Singh et al.			■	■	■	■	■					
	Interview Chatbot	Siswanto et al.						■	■		■			
	CV Screening	Le et al.			■	■	■	■	■					

Figure 5: Case studies

tion from texts in CVs, i.e. matching skills mentioned throughout different projects to job requirements. This model also creates a ranking of applicants with the information gathered from resumes. The IPJF model relies on using semantic correlation from CVs and job descriptions to match employers with applicants by considering both parties' preferences and likelihood to proceed to the next recruiting stage. Both tools are similar in their purpose, which is matching resumes to job requirements, thereby limiting personal candidate data used for screening to relevant criteria, which is compliant with purposefulness measures from our framework. Moreover, helping to automate early recruiting stages by pre-selecting relevant applicants through tools like PROSPECT or IPJF gives recruiting specialists an opportunity to invest more time and effort into the later stages of the assessment process.

Interview chatbot. Siswanto et al. [84] developed a chatbot to interact with applicants in order to evaluate their qualification level by assessing their skills in the course of a written interview. The authors conceptualise their prototype and design their experiments in a manner that is compliant with our framework in terms of insights into the processing of personal data, transparency of the algorithm and explainable results. They enable applicants to see their results and raise doubts about the correctness of their performance's evaluation, which are then processed by recruiting specialists. Such a feedback mechanism is especially valuable for improving AI recruiting algorithms because it allows to record false decisions and erroneous system output.

6 Discussion

With growing legal control and public awareness of AI's influence on traditional business processes, it has become very important for AI software to comply with ethical principles from the early stages of development. The field of AI recruiting is especially affected by this disposition due to the usage of sensitive personal data and significant influence on human well-being [46]. In spite of a variety of AI recruiting services offered on the market, the adoption of such remains low due to concerns about lawful processing of the candidate data and reliability of algorithmic decision-making on the one hand [31][9], and complexity alongside lacking explainability on the other [162]. In order to address these issues, we created an actionable framework for ethical AI in recruiting based on a selection of guidelines and policies

from different interest groups, and subsequently applied it to the prototypes of the algorithms that are relevant to the recruiting process.

6.1 Results

The main result of this thesis is the framework for development, evaluation, and utilisation of ethical AI recruiting software that considers the most important fairness principles and European policies (the GDPR, the AI Act and the Recommendation on the Protection of Individuals with Regard to Automatic Processing of Personal Data in the Context of Profiling) and covers practical recommendations and tools the users may directly use to improve their processes. The novelty factor of this framework lies in that it accumulates knowledge about fair AI from different sources and applies it to the field of recruiting. We demonstrate the application of our framework by using it to analyse publicly available papers describing prototypes of CV screening, video interviewing and conversational AI software. Our analysis illustrates that it covers the details presented in the papers, but it also includes other criteria that we were unable to detect in the analysed studies due to their technical nature and restricted access to the codebase. The principal output of chapter 4 that serves as a basis for the framework is a comprehensive overview of the existing guidelines and regulations of ethical AI that updates and expands the work of Hagendorff [64] from the European perspective. It reveals that data protection and privacy, fairness, explainability, accountability, transparency, and focus on human-wellbeing are the most important principles when developing and evaluating AI algorithms. These findings define the concept of ethical AI and can be used in further research and applications. We believe that our framework may be valuable for other *scholars* studying ethical AI, especially in the context of recruiting, because it contains a comprehensive overview of the best practices and policies collected from different relevant sources, and therefore presents a good basis for future research. The analysis of legal regulations and ethical considerations for high-risk AI can be effectively used by *legal professionals* that specialise in this field. The detailed framework and recommendations we offer might become a valuable resource for *developers* of AI applications, especially due to the uniqueness of this framework's focus on the recruiting process. Lastly, *employers and recruiters* may gain a better understanding of the opportunities, benefits, and constraints of AI integration in their recruiting and hiring strategies.

6.2 Limitations

The primary limitation of our analysis comes from the case studies. Since our framework covers all stages of AI recruiting software adoption from problem analysis to working with the algorithm's output to meet hiring decisions, the information provided in the research papers that present prototypes of the algorithms is not sufficient to properly evaluate every activity of the framework. Moreover, the lack of publicly available codebase for the analysed prototypes prevented us from conducting a thorough technical analysis that would be valuable for the second and third stages of the framework, so we had to rely only on the details presented in the studies. Due to financial, time and permission constraints, we were unable to apply our framework to the enterprise AI recruiting software, which we oriented on during the framework creation. Additionally, some framework positions (activities from the problem analysis and output stages) are relevant primarily for process design, which receives less attention in our thesis than AI architecture. So, the second imitation of the thesis, or rather a potential for future work from a different perspective, is the disproportional focus on the issues of ethical AI assessment, and therefore lack of theoretical basis for restructuring of the recruiting process to efficiently integrate AI software. Additionally, due to the necessary generalisation, our framework might require refining to be applicable to the concrete scenario a user may face.

7 Conclusion

Employers can benefit significantly from adopting AI applications in the course of the digital transformation of their talent acquisition practices. Due to the considerable influence of AI algorithms in recruiting on the lives of candidates, EU policy-makers introduce directives and laws that control the compliance of such systems with existing regulations that serve the well-being of mankind. It is the responsibility of AI developers and users to actively assess their software and undertake measures to mitigate existing biases and safety vulnerabilities to ensure its lawfulness and ethicalness.

We followed the research questions formulated in the introduction, and first, we explored the use case of AI applications in the recruiting processes by analysing modern trends in AI recruiting services on the global market. We

later discussed the issues and concerns regarding their adoption by employers. In order to address one of the main concerns, the uncertainty about the safety and fairness of such applications, we created a comprehensive review of European legal acts and ethical guidelines to assist practitioners and researchers in the definition of fair AI, thus answering the second question. We then summarised our findings and used them to produce a novel framework for self-evaluation of AI recruiting software that can be used during the problem analysis, algorithm development and maintenance, as well as the hiring decision-making stages. Thus, we successfully met our main research goal and created an evaluation framework for AI recruiting software by accumulating legal regulations of the EU, fair AI frameworks and tools, and ethical guidelines from international and non-profit organisations, industry experts and scholars. We consider our framework a valuable contribution to the research of ethical AI that delivers value to different stakeholders (scholars, legal professionals, developers, businesspeople) and a good basis for future research of ethical AI and data-driven transformation of the recruiting processes.

7.1 Future work

Due to the encountered limitations and time constraints, we leave further experiments and framework refinements as plans for potential future work. The following ideas could be explored to expand the value of our proposed framework:

1. *Empirical framework implementation and evaluation.* Gain access to multiple, preferably enterprise-level, AI recruiting applications in order to test the framework in different scenarios empirically, and evaluate proposed tools and recommendations. This evaluation will be most complete if the researchers explore a real use case in an enterprise that plans to utilise AI recruiting software or already does so, to account for the business perspective of the integration.

2. *Qualitative interview study.* Collect feedback from recruiting, AI development, IT system integration and digital transformation specialists to expand the framework from different perspectives and make it more applicable for real-world AI adoption scenarios.

3. *Digital transformation perspective.* Analyse the transformation of the recruiting process with AI adoption in detail, and consider composing

a guide for recruiters that covers the education stage of our framework.

4. *Alternative framework development.* Lastly, despite the recruiting focus of our framework, we see potential in modifying it to fit alternative use cases, especially those that are classified as high-risk in the AI Act and require the processing of personal data, such as the financial and medical industries. Regional differences in policies must also be investigated when altering the framework to be applied in a non-EU legal environment.

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A AI recruiting vendors

	Source																								
Vendors	6	158	53	156	157	109	149	99	38	147	55	134	67	12	107	49	4	164	94	16	56	125	32	13	69	Count
HireVue	■		■				■			■		■	■	■	■	■			■	■				■		13
hireEZ fka. Hiretual							■	■	■	■	■	■	■	■	■				■			■			■	12
Pymetrics	■	■					■			■				■		■	■	■	■	■		■		■		12
SeekOut		■				■	■		■	■	■		■						■			■	■		■	11
Fetcher						■	■		■	■	■		■								■	■	■		■	10
Olivia by Paradox		■					■	■		■		■				■			■			■	■		■	10
Arya by Leoforce						■	■	■	■	■	■	■	■												■	9
Humanly							■		■		■		■		■							■	■		■	8
TurboHire						■		■	■	■	■		■	■											■	8
XOR									■	■	■		■									■	■	■	■	8
HiredScore								■		■		■	■			■			■					■		7
Mya (acquired by StepStone)	■									■		■		■		■				■				■		7
Eightfold		■					■	■		■					■							■				6
Harver					■							■	■		■	■		■								6
Ideal.	■											■	■			■	■			■						6
MyInterview				■			■			■			■									■	■			6
Loxo							■							■					■			■	■			5
Vervoe				■						■			■					■	■							5
Zoho Recruit	■					■				■				■			■									5
Arctic Shores	■				■											■	■									4
CVViZ	■							■		■		■														4
pandoIQ by PandoLogic fka. Veritone	■									■							■							■		4
Talkpush					■										■						■	■				4
Beamery	■											■	■													3
Ceipal								■		■		■														3
HiringSolved										■						■			■							3
Knack	■															■	■									3
Montage	■		■														■									3
Skillate								■		■				■												3
Talocity												■	■	■												3
Wepow	■		■														■									3
XOPA								■		■					■											3
AmazingHiring							■								■											2
eva.ai								■		■																2
Headstart					■											■										2
IBM Watson	■																■									2
Kandio												■						■								2
Manatal								■							■											2
Pomato												■	■													2
Talent Cube	■																■									2
Aivi	■																									1
Checkr		■																								1
Check's	■																									1
Cleard Life				■																						1
Curious Thing				■																						1
GoodHire	■																									1
HireRight	■																									1
Human			■																							1
Hyreo										■																1
IBM Kenexa	■																									1
Inbenta	■																									1
Intelligo	■																									1
Kore	■																									1
Kula A.I.				■																						1
Neufast					■																					1
NextIT	■																									1
Nuance	■																									1
Onfido	■																									1
Personetics	■																									1
Phenom People		■																								1
Retorio											■															1
Sapia fka. PredictiveHire				■																						1
Scout Exchange		■																								1
Scoutible																■										1
Sterling Talent	■																									1
Talent Recruit	■																									1

Figure 6: AI recruiting vendors

B Tools and recommendations

Activities	Tools & Recommendations	Sources
1. Problem analysis		
1.1. Problem definition		
1.1.1.	Stakeholder needs analysis and other business analysis techniques	
1.1.2.	Introduce roles of Data Protection Officer, AI ethics committee	GDPR [47], Blackman [15]
1.1.3.	Employee observation, job analysis questionnaire	https://hr.tsu.edu/wp-content/uploads/2013/03/job_analysis_questionnaire.pdf
1.1.4.	Choose appropriate criteria based on the results of job analysis questionnaires	https://hr.tsu.edu/wp-content/uploads/2013/03/job_analysis_questionnaire.pdf
1.1.5.	Equal Employment Opportunity checklist, selection of inclusive assessment tools	
1.1.6.	Textio, Diversifier by Witty Works	https://textio.com/, https://diversifier.witty.works/
1.2. Requirements analysis for the solution		
1.2.1.	Cost-benefit analysis, value-added analysis, other decision-making frameworks	
1.2.2.	Business analysis techniques, testimonials, research	
1.2.3.	Software selection framework	Colombo & Francalanci [26]
1.2.4.	Build vs. buy decision framework	Windward [168]
1.2.5.	Questionnaires, interviews with recruiters	
1.2.6.	People + AI Guidebook	https://pair.withgoogle.com/guidebook/
1.3. Risk assessment and compliance with legal and ethical guidelines		
1.3.1.	EUR-Lex, AI Ethics Guidelines Global Inventory by Algorithm Watch	https://eur-lex.europa.eu/homepage.html?locale=en, https://inventory.algorithmwatch.org/
1.3.2.	Tensorflow Responsible AI toolkit	https://www.tensorflow.org/responsible_ai
1.3.3.	Apply findings from the previous steps to the recruiting process	Linden [98]
1.3.4.	People + AI Guidebook	https://pair.withgoogle.com/guidebook/
continued on the next page		

Figure 7: Tools and recommendations

continued		
Activities	**Tools & Recommendations**	**Sources**
2. Data		
2.1. Data collection		
2.1.1.	Check for underrepresented groups and consider reweighting or oversampling	Paul et al. [129]
2.1.2.	Data quality dashboard	https://www.triniti.com/data-quality-dashboard
2.1.3.	Consent form with explicit list of gathered data and its intended usage	ICO [78]
2.1.4.	Data protection impact assessment	ICO [79]
2.1.5.	GDPR checklist	https://gdpr.eu/checklist/
2.2. Data transfer		
2.2.1.	Differential privacy (OpenDP), zero knowledge proofs (ZKProof), synthetic data (MostlyAI)	https://opendp.org/, https://docs.zkproof.org/, https://mostly.ai/
2.2.2.	Security and privacy controls guidelines	NIST [122]
2.2.3.	GDPR checklist*	https://gdpr.eu/checklist/
2.3. Data processing		
2.3.1.	Differential privacy (OpenDP), synthetic data (MostlyAI), TensorFlow Responsible AI toolkit	https://opendp.org/, https://mostly.ai/, https://www.tensorflow.org/responsible_ai
2.3.2.	TensorFlow Responsible AI toolkit	https://www.tensorflow.org/responsible_ai
2.3.3.	TensorFlow Responsible AI toolkit Audit AI	https://www.tensorflow.org/responsible_ai, https://github.com/pymetrics/audit-ai
2.3.4.	Differential privacy (OpenDP), synthetic data (MostlyAI)	https://opendp.org/, https://mostly.ai/
2.3.5.	GDPR checklist	https://gdpr.eu/checklist/
2.4. Data storage		
2.4.1.	Cyber Security Framework	NIST [121]
2.4.2.	Cyber Security Framework	NIST [121]
2.4.3.	Request form for restriction of data processing and storage	ICO [80]
2.4.4.	Request form for restriction of data processing and storage	ICO [80]
2.4.5.	GDPR checklist	https://gdpr.eu/checklist/
continued on the next page		

Figure 7 (Cont.): Tools and recommendations

continued		
Activities	**Tools & Recommendations**	**Sources**
3. Algorithm		
3.1. Training		
3.1.1.	Strictly depends on the algorithm in question and requires separate research	
3.1.2.	Know Your Data	https://knowyourdata.withgoogle.com/
3.1.3.	TensorFlow Responsible AI toolkit	https://www.tensorflow.org/responsible_ai
3.1.4.	InterpretML	https://interpret.ml/
3.1.5.		
3.2. Testing		
3.2.1.	AI 360 Fairness, Fairlearn	https://aif360.mybluemix.net/, https://fairlearn.org/
3.2.2.	Refine success criteria with ethical considerations	Lee et al. [91]
3.2.3.	AIBench	http://www.aibench.org/
3.2.4.	AI Fairness 360, Fairlearn, Audit AI, TensorFlow Responsible AI toolkit, InterpretML	https://aif360.mybluemix.net/, https://fairlearn.org/, https://github.com/pymetrics/audit-ai, https://www.tensorflow.org/responsible_ai, https://interpret.ml/
3.2.5.	V&V testing	Falco et al. [50]
3.2.6.	Design practices for explainable AI	Liao et al. [95]
3.3. Review		
3.3.1.	AI Fairness 360, Fairlearn, Audit AI, TensorFlow Responsible AI toolkit, InterpretML	https://aif360.mybluemix.net/, https://fairlearn.org/, https://github.com/pymetrics/audit-ai, https://www.tensorflow.org/responsible_ai, https://interpret.ml/
3.3.2.	Guidelines for AI recruiting audit	Kazim et al. [86]
3.3.3.	Technical documentation	Whitaker J. and Mancini R. [166]
3.4. Monitoring and maintenance		
3.4.1.	Traceable AI tools	Mora-Cantallops et al. [117]
3.4.2.	Model Cards (MCT), Azure Monitor	https://www.tensorflow.org/responsible_ai/model_card_toolkit/guide, https://azure.microsoft.com/products/monitor/
3.4.3.	Model Cards (MCT), Azure Monitor	https://www.tensorflow.org/responsible_ai/model_card_toolkit/, https://azure.microsoft.com/products/monitor/
3.4.4.	Agile software development techniques	
3.4.5.	Cyber Security Framework	NIST [121]
3.4.6.	Cyber Security Framework	NIST [121]
3.4.7.	Cyber Security Framework	NIST [121]
continued on the next page		

Figure 7 (Cont.): Tools and recommendations

continued		
Activities	**Tools & Recommendations**	**Sources**
4. Output		
4.1. Education		
4.1.1.	Workshops (e.g. People + AI workshops guide), publications on the company's website	https://pair.withgoogle.com/guidebook/workshop
4.1.2.	Workshops	
4.2. Control		
4.2.1.	Documentation, process maps and flowcharts (Lucidchart)	https://www.lucidchart.com/
4.2.2.		
4.2.3.		
4.3. Evaluation and improvement		
4.3.1.	DARPA's Explainable Artificial Intelligence (XAI) Program	Gunning [63]
4.3.2.		
4.3.3.	People + AI Guidebook	https://pair.withgoogle.com/chapter/feedback-controls/
4.3.4.	People + AI Guidebook	https://pair.withgoogle.com/chapter/feedback-controls/
4.3.5.	Dashboarding and reporting tools (MS PowerBI, Tableau, Zoho)	https://powerbi.microsoft.com/, https://www.tableau.com/, https://www.zoho.com/
4.3.6.	Agile software development techniques	
4.3.7.	AlgortihmWatch	https://algorithmwatch.org/

Figure 7 (Cont.): Tools and recommendations