Blockchain and Machine Learning in Talent Acquisition: A Review on Credential Verification and Recruitment Optimization

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The rapid evolution of recruitment processes has prompted organizations to explore advanced technologies that enhance efficiency, transparency, and fairness in talent acquisition. This review critically examines the integration of Blockchain and Machine Learning (ML) as transformative tools in addressing long-standing challenges such as credential fraud, skills mismatch, unconscious bias, and lack of process transparency. Blockchain provides a decentralized, immutable ledger for secure storage and verification of academic and professional credentials, thereby reducing fraudulent claims and streamlining verification through smart contracts. The convergence of these technologies creates robust frameworks where ML algorithms operate on authenticated data supplied by blockchain systems, reinforcing trust, accountability, and efficiency in recruitment workflows. This study highlights both the transformative opportunities and practical challenges of these technologies, providing insights for academia, practitioners, and policymakers to design sustainable recruitment strategies aligned with modern workforce demands.

Keywords: *Machine Learning, Blockchain, Talent acquisition, Credential verification*
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1 Introduction

The integration of advanced technologies in recruitment processes and addressing challenges in today's competitive job market. Blockchain technology offers opportunities to enhance recruitment efficiency, reduce costs, and mitigate fraud risks [1]. Moreover, talent acquisition is the strategic process of identifying, attracting, recruiting, and onboarding individuals whose skills, qualifications, and values align with an organization's goals and culture [2]. This function plays a pivotal role in achieving organizational success, as hiring the right talent directly impacts productivity, innovation, and long-term sustainability. However, despite its critical importance, talent acquisition continues to face persistent and evolving challenges that hinder efficiency and effectiveness. One of the most pressing concerns is credential fraud, where candidates falsify academic qualifications, professional certifications, and prior work experiences. Such misrepresentations lead to inaccurate assessments and poor hiring decisions, resulting in financial losses, reduced productivity, and long skills gap-term damage to organizational reputation [3]. Another major issue is the skills gap, where candidates' capabilities fail to align with the dynamic demands of industry. This mismatch causes increased training costs, prolonged hiring cycles, and decreased operational efficiency [4].

In addition, unconscious bias remains a critical obstacle in traditional recruitment practices. Hiring decisions are often unintentionally influenced by subjective factors such as gender, ethnicity, age, or educational background, leading to discriminatory practices and the potential exclusion of highly qualified candidates. This bias is exacerbated when hiring managers face overwhelming volumes of applications, further increasing the likelihood of inconsistent and unfair shortlisting decisions [5]. Lack of transparency in recruitment processes, arising from inconsistent credential

verification methods and the absence of standardized practices, further diminishes trust between employers and job seekers. In response to these challenges, organizations are increasingly turning to emerging technologies such as Blockchain and Machine Learning (ML) to modernize their talent acquisition strategies. These technologies offer advanced solutions to enhance security, transparency, efficiency, and fairness in recruitment processes. Blockchain technology, a decentralized and immutable digital ledger, facilitates secure and verifiable data storage, ensuring that academic credentials, professional achievements, and employment history are recorded permanently and authenticated automatically through smart contracts [6] [7]. On the other hand, Machine Learning introduces intelligent automation and predictive analytics into recruitment workflows. ML algorithms can streamline processes such as candidate sourcing, resume parsing, and job-candidate matching. Technologies such as Natural Language Processing (NLP) allow for sophisticated language analysis, Robotic Process Automation (RPA) enables the automation of repetitive tasks, and predictive models help identify high-potential candidates. Collectively, these tools not only enhance hiring efficiency but also help reduce human bias in decision-making [8].

Besides that, blockchain enhances the authenticity and permanence of degrees, certifications, and work histories, mitigating fraudulent claims and optimizing hiring decisions [3][9]. Initiatives such as the Quali-Chain project have demonstrated the ability of blockchain-based systems to create secure, transparent, and efficient frameworks for competency management and recruitment [6] [4]. Similarly, it is emphasized the role of blockchain in addressing credentialing challenges in digitally evolving sectors, particularly for small enterprises [10].

Despite its promise, blockchain adoption in recruitment faces technological and legislative hurdles. Compatibility issues between various blockchain platforms and traditional credentialing systems remain significant barriers [1]. Additionally, concerns surrounding data privacy, regulatory compliance, and employer acceptance continue to pose challenges for widespread implementation [11].

Machine learning has revolutionized talent acquisition by introducing predictive analytics, NLP, and deep learning models into recruitment workflows. Predictive analytics enables organizations to forecast candidate success, tenure, and cultural fit based on historical hiring data. NLP technologies enhance the parsing of resumes, evaluation of interview responses, and sentiment analysis, providing recruiters with more objective and refined candidate assessments [5] [12]. Deep learning algorithms further refine candidate recommendations by detecting complex patterns across extensive datasets, thereby reducing the time and manual effort required for screening [13] [8].

Importantly, ML contributes to bias detection and mitigation in hiring processes. Traditional recruitment methods often exhibit unconscious biases that influence outcomes, whereas ML systems—when trained on diverse and balanced datasets—can prioritize objective candidate attributes over demographic markers [14] [15]. Studies [5] have demonstrated the effectiveness of anonymized AI-driven screening platforms in reducing human biases. Additionally, AI-driven applicant tracking systems (ATS) that focus on competency alignment help ensure compliance with equal employment opportunity laws, promoting fairness and transparency in recruitment evaluations [2] [16] [17]. Nonetheless, concerns remain regarding algorithmic fairness. Critics argue that biased training data can inadvertently perpetuate discrimination rather than eliminate it, highlighting the need for continuous monitoring and updating of ML recruitment models [9].

The convergence of blockchain and machine learning in recruitment presents a unique opportunity to establish more secure, transparent, and efficient hiring ecosystems. Blockchain-secured AI models ensure that machine learning algorithms operate on

authenticated, tamper-proof data, thereby enhancing the reliability of candidate [4] [1]. Blockchain not only reinforces trust in AI-driven assessments but also provides an immutable audit trail of decision-making processes, promoting accountability and transparency [1] [10]. The seamless integration between verified credentials on blockchain and ML-powered candidate evaluation systems streamlines hiring workflows. Employers can access validated academic and professional records in real time, while machine learning models match these credentials against job requirements, cultural fit, and organizational needs [17] [11]. Practical implementations, such as blockchain-based smart contract systems for real-time verification [9], have demonstrated improvements in recruitment efficiency, accuracy, and fairness.

However, integration challenges persist. The immutable nature of blockchain raises concerns about error correction in credential records, necessitating mechanisms for dispute resolution [6]. Simultaneously, ML-driven recruitment systems must remain adaptable to changing regulations and ethical standards to avoid reinforcing systemic biases [4]. Companies must carefully balance the predictive power of machine learning with the secure data management offered by blockchain to achieve a truly data-driven and fair recruitment process [10].

This study aims to critically examine how blockchain and machine learning technologies can effectively address the key challenges in talent acquisition by analyzing their transformative potential, evaluating associated risks and ethical considerations, and identifying gaps in current academic and industry practices to inform future research and implementation (Figure 1).

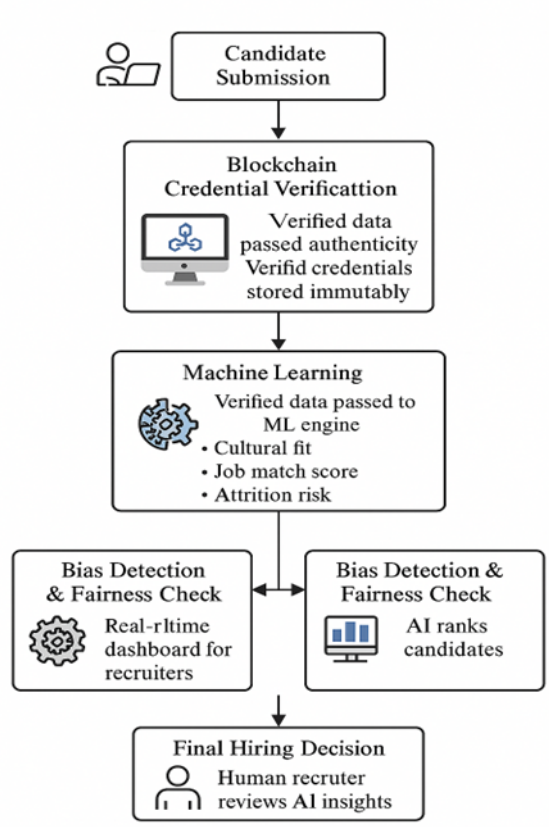

Fig. 1. Integrated Framework for Blockchain and Machine Learning in Talent Acquisition

2.0 Methodology

2.1 Template Research Design

This study adopts a narrative literature review methodology, specifically structured to examine the intersection of blockchain technology and machine learning in the context of talent acquisition and human resource management (HRM). A narrative review is appropriate for this research due to its flexibility in synthesizing diverse academic perspectives, particularly in fields where the literature is rapidly evolving, methodologically heterogeneous, and distributed across multiple disciplines.

Unlike systematic reviews that rely on highly restrictive inclusion protocols and replicable meta-analytical frameworks, a narrative review provides conceptual breadth and allows for critical interpretation of themes and trends. This approach enables the consolidation of findings across technical disciplines (e.g., blockchain architecture, algorithmic bias mitigation) and managerial fields (e.g., talent sourcing, credential authentication), which may not be easily

harmonized through a strictly quantitative synthesis.

The review aims to develop a comprehensive and critical understanding of how blockchain and ML are being applied to address persistent recruitment challenges, including credential fraud, inefficiency, and discriminatory practices. Moreover, it explores the opportunities, limitations, and future directions associated with the integration of these technologies in both academic theory and industrial practice.

This methodological design ensures a rigorous yet interpretive analysis, making it possible to map technological trends, compare conceptual frameworks, and highlight interdisciplinary gaps. By focusing exclusively on peer-reviewed academic publications, this review maintains a high standard of scholarly credibility while offering insights relevant to practitioners and researchers alike.

2.2 Literature Selection Criteria

This study applied a structured set of criteria to ensure the inclusion of high-quality, relevant literature. Only peer-reviewed journal articles and conference papers published between 2017 and 2024 were considered, focusing on the application of blockchain and machine learning in HRM and talent acquisition. Sources were drawn from reputable academic databases such as IEEE Xplore, SpringerLink, and ScienceDirect. The selection emphasized topical relevance covering credential verification, smart contracts, and bias detection and employed a keyword-based Boolean search strategy to ensure comprehensive and focused coverage. Table 1 shows the criteria followed upon literature collection for this study.

Table 1. Literature Collection

Criterion Type	Explanation	Purpose	Inclusion/Exclusion Criteria
Source type	Only peer-reviewed journal articles, scholarly conference papers, and proceedings were considered. Excluded sources include grey literature, whitepapers, corporate publications, and non-peer-reviewed case studies.	Ensures academic rigor and scholarly credibility by selecting validated and reliable sources.	Included: Peer-reviewed journals and conferences; Excluded: Grey literature, whitepapers, and non-peer-reviewed reports.
Content Relevance	Publications must be directly related to the intersection of blockchain and machine learning within HRM and talent acquisition, covering specific topics such as blockchain for credential verification, machine learning for bias detection, or smart contract-based hiring.	Ensures that the review is focused on the intersection of the two key technologies within the HRM context.	Included: Blockchain in HRM, ML in recruitment, credential verification, bias detection; Excluded: Irrelevant topics, unrelated technologies.

Criterion Type	Explanation	Purpose	Inclusion/Exclusion Criteria
Scholarly Integrity	Studies must be sourced from high-impact, reputable academic repositories and databases such as IEEE Xplore, SpringerLink, Elsevier's ScienceDirect, Wiley Online Library, and the ACM Digital Library.	Ensures that the literature meets high standards of academic quality and peer validation.	Included: Articles from IEEE Xplore, SpringerLink, Elsevier, Wiley, ACM Digital Library; Excluded: Articles from untrusted sources.
Time Frame	The review focused on studies published between 2017 and 2024. This period was chosen to capture the most recent and relevant advancements in blockchain and machine learning technologies.	Reflects the most up-to-date developments in the field and captures the period of significant technological application in HRM.	Included: Studies from 2017-2024; Excluded: Studies published before 2017 or after 2024.

2.3 Data Collection and Analysis

The data collection process employed a multi-stage iterative search across selected academic databases and repositories to ensure comprehensive coverage of relevant literature (Figure 2). Initially, a preliminary search was conducted using predefined keywords to broadly identify potential publications. Following this, a filtering and screening stage involved the removal of duplicate entries and a subsequent review of titles and abstracts to ascertain their thematic relevance to the study's focus. The remaining articles then underwent a full-text evaluation, which entailed a detailed reading and critical appraisal to assess their methodological rigor, direct relevance to the review's objectives, and overall contribution to the existing knowledge in the field. Throughout these stages, meticulous records of all inclusion and exclusion decisions were maintained to uphold transparency and ensure consistency in the selection process.

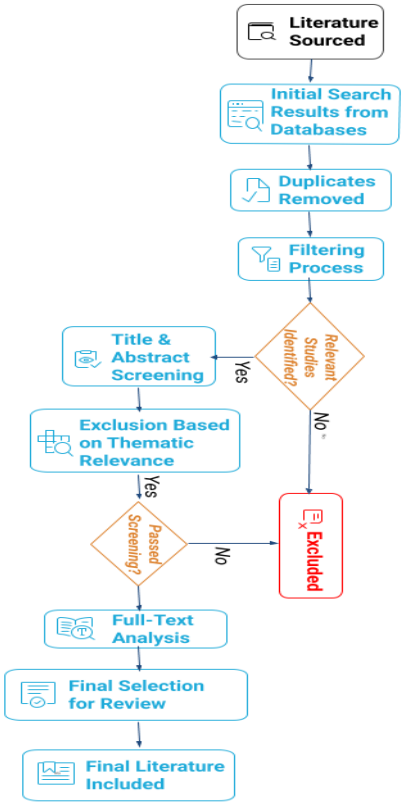

Fig. 2. Data Collection and Analysis

A qualitative thematic analysis was performed to systematically identify and synthesize the prominent patterns and key insights present across the selected studies. This analytical process involved a series of structured steps to ensure a comprehensive understanding of the literature. Initially, Open Coding was conducted, where key concepts, relevant technologies, associated challenges, and observed outcomes were carefully extracted from each individual study. Following this, Theme Development was initiated by grouping these initial codes into preliminary themes based on their conceptual similarities and relationships. The themes then underwent a rigorous process of Theme Refinement, involving iterative review and comparative analysis to ensure each theme was coherent, distinct from others, and clearly relevant to the research focus. The culmination of this process was the establishment of a Final Categorization, which organized the synthesized insights into four central themes: Blockchain for Secure Credential Verification, focusing on how decentralized ledgers, smart contracts, and self-sovereign identity systems enhance transparency and trust in the recruitment process; Machine Learning for Talent Analytics and Decision-Making, analyzing ML-driven techniques such as resume parsing, predictive hiring models, candidate recommendation systems, and mechanisms for mitigating bias; Challenges and Limitations, discussing the obstacles related to blockchain scalability, interoperability, regulatory concerns, data privacy, and ensuring algorithmic fairness; and Future Research Directions, identifying opportunities for innovation, including the development of hybrid blockchain-ML frameworks, privacy-preserving AI models, and standardized decentralized identity protocols. By synthesizing insights across these critical thematic areas, this review provides a comprehensive and critical evaluation of the applications of blockchain and machine learning in talent acquisition while simultaneously highlighting crucial gaps that warrant future scholarly and industrial exploration.

3 Literature Review

3.1 Secure storage and verification of credentials.

Blockchain technology provides unique options for the secure storage and validation of credentials in talent acquisition and education [2]. Several research studies suggest that blockchain-based systems for maintaining educational and acquisition credentials to manage issues, including manipulation of data, falsification, and costly verification procedures [18] [19]. Blockchain-based solutions provide the potential role of recruiters in the recruitment industry by improving transaction speed, reliability, and cost-effectiveness. Furthermore, blockchain solutions based on Ethereum and smart contracts guarantee data integrity, while decentralized storage systems like IPFS boost security [18] [20].

Non-fungible tokens (NFTs) have also been investigated to issue and confirm academic credentials while guaranteeing GDPR compliance as well as offering users with ownership over their personal data [21]. Additionally, cloud storage systems' confidentiality and authenticity can be improved by connecting blockchain technology with methods of encryption like RSA [22]. Although there are concerns that algorithms function as "black boxes" with hidden biases, it is possible to find out to gain more knowledge about how they make decisions. When tools are utilized to detect the elements impacting algorithmic inferences, computer scoring can help eliminate human biases in personnel selection by eliminating biased features from training data [23].

3.2 Use of smart contracts for hiring agreements

Smart contracts and blockchain technology provide opportunities to boost human resources management's hiring practices. In the recruitment procedure, these technologies can enhance output, reduce costs, and improve the safety of transactions [1][24]. Moreover, fairness, honesty, and auditability in AI-driven decision-making systems can be ensured by these digital agreements [25].

Particularly in bigger company networks or ecosystems, blockchain-based frameworks with smart contracts may promote supply chain collaboration by promoting traceability, which is transparency, and participant confidence [26].

However, the use of blockchain in hiring is expected to be gradual due to organizational, technological, and environmental obstacles [1]. The use of AI technology has risen over the past few decades, regardless of the industry—IT/ITES, healthcare, banking, engineering, manufacturing, and increased competition for talent. Moreover, AI is actively promoting a range of HRM activities by simplifying and automating HR tasks, minimizing stress, and improving quick outputs [27].

Apart from this, the hiring verification procedure takes minutes instead of weeks because of the blockchain-based approach [28]. An average of $14,900 was lost by companies for each "bad hire," and 74% of employers reported having a mistake in hiring someone. Likewise, according to that survey, 75% of candidates change their resumes based on the specific position they are looking for [29]. It is asserted that AI is used in many kinds of processes, including applicant sourcing, screening, job posting, remote worker recruiting, diversity hiring, data gathering, and training [30].

3.3 Resume screening using NLP and deep learning

Recent studies show significant development in natural language processing (NLP) and machine learning (ML) that are used in healthcare and recruitment fields. Also, CNN-GRU/BERT models have demonstrated 93.51% accuracy in classifying engineering students' resumes [31] in contrast to S-BERT has achieved 90% accuracy in resume screening, processing resumes in just 0.233 seconds each [32]. Because there are plenty of resumes, hiring supervisors can miss out on extremely qualified applicants. When the list is complete or has enough approved software, the following step proceeds. Even though there is a support vector machine-based method that has been developed to improve candidate shortlisting to increase efficiency and lower costs [33].

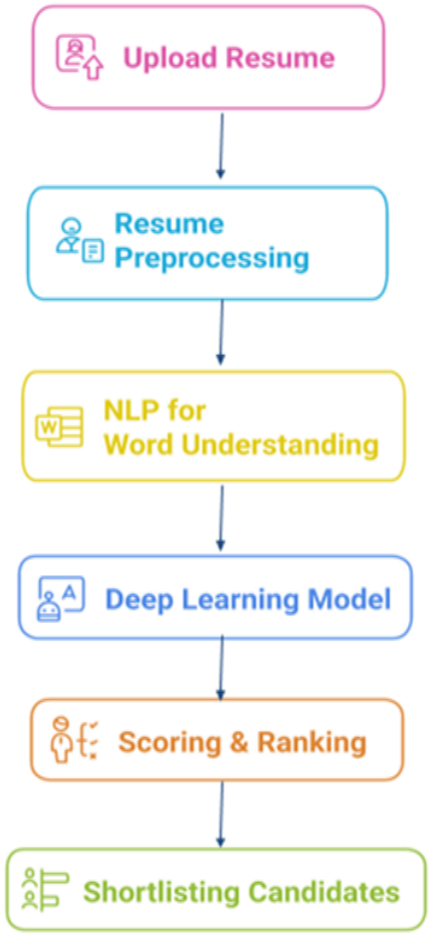

Fig. 3. Resume Screening Process

The flowchart from Figure 3 shows that candidates need to submit their resume first through the online portal. Then in the preprocessing system, unnecessary text is eliminated, followed by NLP evaluating key information such as skills, experience, and education [34] [35]. Afterwards, deep learning techniques evaluate resumes based on job requirements and rank resume information [36] [37] [38] [39]. After this, the system makes a shortlist of candidates. Apart from this, to identify patterns and create predictions based on new data, machine learning involves training models on datasets. Moreover, NLP, which makes it easy for computers to understand and evaluate spoken and written human language, and the main tool used for resume screening. In addition, the process of resume screening is more

accurate and automatic, NLP integrates machine learning, deep learning, statistical methods, and computational linguistics (rule-based language modelling) [40].

3.4 Predictive hiring models for performance estimation

A particular type of artificial intelligence called machine learning helps computers to learn from data without explicit programming. Additionally, to find patterns in data and make predictions or decisions, machine learning algorithms use statistical approaches. By automating resume screening, identifying the best candidates based on job requirements, and even performing initial interviews, ML may speed up the hiring process. For quickly identifying the most suitable candidates, these systems can analyze online assessments, social media profiles, and resumes [41].

It is noticed strategies for forecasting employee performance ratings to make appraisals more accurate [42]. After comparing machine learning models for loss of staff prediction, it was found that Logistic Regression was the most successful, with an accuracy rate of 88% [43]. Creating a machine-learning method for clinical trial research ranking is better than traditional industry standards in terms of human recruitment predictions [44].

3.5 Increasing automation, transparency, and fairness in hiring.

AI can significantly contribute to reducing biases in recruitment choices, enhancing interactions between workers, improving metrics, as well as improving the atmosphere of work [5]. On top of that, there may be benefits to the increasing application of blockchain and machine learning (ML) in recruitment processes, but there are risks as well. Higher prediction accuracy and fairness are assured by ML-based selection; yet there remain difficulties in establishing reliable criteria, ensuring transparency, and maintaining equity [45].

Despite organizational and technical obstacles, blockchain technology may enhance hiring by improving speed, reliability, and cost-efficiency [1]. Systematic algorithm reviews are crucial to addressing possible biases and inspiring appropriate implementation and these audits need to analyze algorithmic bias, find suitable audit opportunities, evaluate risks, and measure transparency in AI-driven hiring processes [46].

4 Discussion

The integration of blockchain and AI-driven recruitment in HRM presents transformative opportunities, but it also faces several critical challenges. These challenges are primarily related to blockchain adoption barriers, machine learning concerns, and integration issues (Figure 4), each of which impacts the scalability and efficiency of HRM in the biotechnology sector.

4.1 Scalability Issues

Scalability is one of the most pressing concerns with blockchain deployment, since traditional blockchain systems struggle with huge transaction volumes and processing speeds. Proof of Work (PoW) techniques used in public blockchains such as Ethereum cause delays and incur significant computing costs [1]. The difficulty of transaction throughput has an impact on the blockchain's ability to handle HR-related data in real time, including automated recruiting, payroll processing, and employee performance tracking. To fully leverage blockchain and AI in HRM, organizations must develop standard blockchain protocols for HR applications [47] improve AI fairness models to prevent bias in recruitment and workforce analytics [48] invest in scalable blockchain solutions to reduce costs and improve efficiency [49] and develop hybrid AI-blockchain architectures for better system integration. While hybrid blockchain solutions that integrate public and private blockchains can improve both speed and security in HR applications [50] layer 2 solutions such as sidechains and sharding can further increase transaction speeds and lower costs.

4.2 Lack of Standardization

The lack of worldwide HR blockchain standards leads to compatibility issues. Many businesses employ multiple HRM software programs that may not allow blockchain integration, leading to fragmented deployments [46].In the absence of industry-wide standard blockchain protocols, Organizations looking to maximize the potential of blockchain and AI in human resource management should establish standard blockchain protocols, improve AI fairness models, invest in scalable blockchain solutions, and create hybrid AI-blockchain architectures [46] . Layer 2 solutions enhance transaction speeds and decrease costs, whereas hybrid blockchain models improve security [49] [51]. Interoperable blockchain protocols make global HR processes more consistent. For this process to work, governments, HR technology providers, and legal experts need to work together [46].

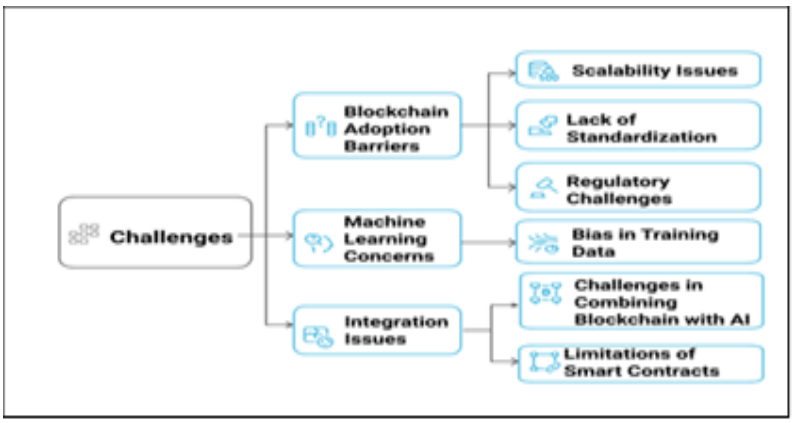

Fig. 4. AI and Blockchain Integration Challenge

4.3 Regulatory Challenge

Data protection rules and regulations, especially the General Data Protection Regulation (GDPR), call into question blockchain technology's immutability. The "right to be forgotten" under GDPR poses issues for permanent ledger-based systems, creating questions about employee privacy and compliance [52].

Furthermore, cross-border compliance raises legal complexity owing to differences in work legislation among nations. Multinational biotechnology businesses that use blockchains for global workforce management must follow data residency requirements, which limit the decentralized storage of employee records across many jurisdictions [53].

4.4 Bias in Training Data

Machine learning models in human resource management depend on historical data, potentially perpetuating biases in hiring, promotions, and salary determinations. Studies indicate that AI-driven recruitment algorithms may exhibit bias towards specific demographics, resulting in inequitable hiring practices [45].

There are big worries about bias in AI-driven talent acquisition, especially since under-represented groups might be left out because of biased historical datasets, which would make the workforce less diverse [54]. Organizations aiming to optimize blockchain and AI in human resource management should focus on improving AI fairness, investing in scalable solutions, and integrating hybrid AI/blockchain architectures [46] [49] [52]. Layer 2 solutions enhance transaction speed, hybrid blockchains bolster security, and interoperability facilitates global consistency [49] [51]. Permissioned blockchains govern data access, whereas zero-knowledge proofs (ZKP) facilitate secure data disclosure [49] [54]. Fairness-aware machine learning models mitigate bias, while regular audits serve to prevent discrimination in human resources decisions [51].

4.5 Challenges in Combining Blockchain with AI-Driven Recruitment

The integration of blockchain and AI in human resource management poses both technical and operational challenges. Data fragmentation presents a challenge, as AI models necessitate centralized training datasets, while blockchain functions through decentralized ledgers, complicating data synchronization [49].

4.6 Limitations of Smart Contracts

Smart contracts do not possess adaptive learning capabilities, rendering them inadequate for dynamic HR decision-making [46]. These systems incur significant computational expenses. AI-driven HRM systems necessitate extensive data processing, resulting in elevated blockchain transaction fees and increased energy consumption [55].

5 Future Research Directions

The integration of blockchain technology and machine learning in talent acquisition brought innovations to credential verification through blockchain and enabled reduced bias for recruiters through ML and automated recruitment processes. Current research provides compelling findings, paper, but academic and industrial institutions must make concentrated efforts to study the existing knowledge gaps. Future research priorities will emerge from the analysis of this paper, which focuses on the barriers and thematic areas along with the identified challenges.

A critical area for research advancement involves creating unified architectures that unite blockchain technology with machine learning in protected and coherent ways (Figure 5). According to [4] blockchain uses its immutable data storage feature to create trust while ML operates in recruitment workflows for predictive intelligence and automation. Disconnecting these technologies proves problematic for organizations, according to research by [1] and [10] shows that deployment creates isolated and inconsistent solutions. Research must develop integrated systems using blockchain to verify candidate information that ML algorithms will utilize for applicant ranking as well as performance prediction and hiring bias detection.

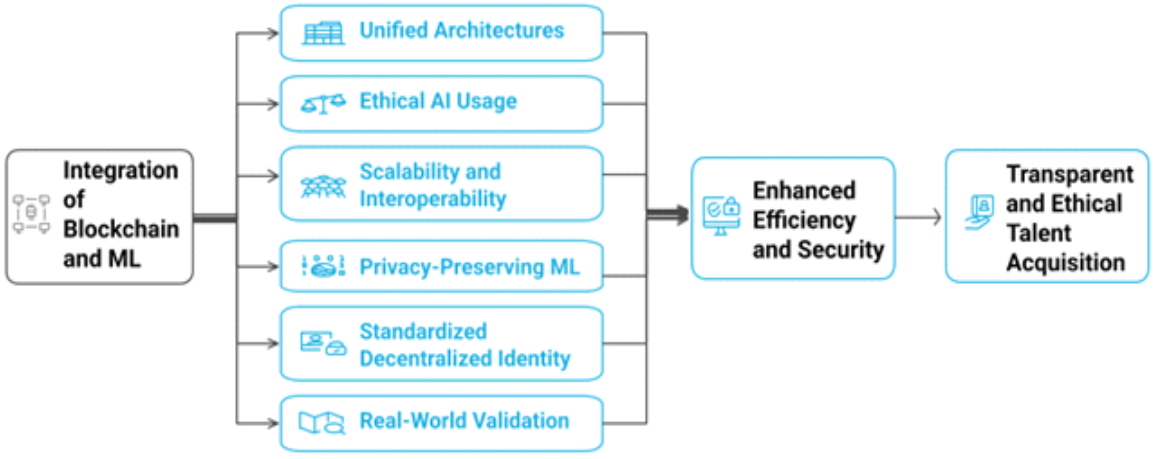

Fig. 5. Future Research Directions

Enhancing the ethical standards along with explainable usage of AI in recruitment needs immediate attention as an essential priority. [5] together with [9] state that ML systems maintain high efficiency but simultaneously absorb biases from historical training data, which might result in discriminatory decisions. Experts are working to establish explainable AI (XAI) tools made specifically for human resources contexts, although studies need additional work to develop these tools effectively. These should allow stakeholders to interpret ML decisions and

ensure compliance with employment regulations and fairness norms [4].

The issue of blockchain scalability and interoperability also remains underexplored. The current blockchain systems effectively perform credential verification according to [6] and [7] but experience performance bottlenecks with existing HR system interfaces [1]. Science-based analysis requires testing of Layer 2 scaling techniques such as sidechains and sharding while developing standardized protocols for cross-platform credential exchange. Real-time hiring capabilities along with lower operational costs emerge as the planned improvements that benefit both substantial companies and organizations that recruit globally.

The study recognizes an urgent requirement to develop privacy-preserving machine learning systems in blockchain-integrated recruitment frameworks. While blockchain ensures secure and verifiable storage of applicant records, ML models require access to potentially sensitive personal data. Future work should examine the integration of federated learning and homomorphic encryption in these systems, enabling decentralized AI training while preserving data confidentiality and complying with regulations like GDPR [52] [53].

The importance of standardizing decentralized identity (DID) and digital credentialing systems also emerges as a vital research trajectory. [2] and [29] underscore the potential of self-sovereign identity (SSI) frameworks in giving candidates control over their data. However, interoperability and verification consistency across institutions and employers remain unresolved. Collaborative research involving academia, industry, and regulatory bodies is required to develop globally accepted standards for blockchain-based identities.

Lastly, real-world validation and adoption studies are limited in the current literature. Most of the work reviewed, including that by [12] and [17] focuses on conceptual frameworks or technical simulations. Future studies should emphasize user-centered design and empirical testing involving HR professionals and job seekers to understand usability, trust, and adoption barriers. Additionally, case studies and field experiments across diverse organizational contexts can provide actionable insights into the operational viability and impact of blockchain-ML recruitment platforms.

While blockchain and ML hold immense promise in transforming recruitment systems, their combined implementation raises new research questions around integration, fairness, scalability, privacy, and standardization. Addressing these gaps will not only enhance hiring efficiency and security but also contribute to the development of transparent, ethical, and inclusive talent acquisition ecosystems. By pursuing the directions outlined above, future research can ensure that technological advancements align with the evolving expectations of modern organizations and global labor markets.

6 Conclusion

This systematic research studied the use of Blockchain technology and Machine Learning in talent acquisition, addressing critical issues such as credential fraud, skills gaps, unconscious prejudice, and a lack of openness in recruiting procedures. The study found that these developing technologies have the potential to dramatically improve the efficiency and integrity of recruiting operations. The key findings show that Blockchain may provide a secure and immutable verification framework, whilst Machine Learning can use advanced algorithms and predictive analytics to simplify candidate sourcing and minimize human bias. However, the study identified many shortcomings. Integrating Blockchain with AI-driven recruiting systems presents technical and operational issues that must be properly managed. Challenges to smooth deployment included data fragmentation, computational expenses associated with smart contracts, and the necessity for ongoing adaptability to legislative changes. For successful adoption, organizations should consider creating hybrid architectures that

effectively combine these technologies while addressing potential downsides. Investment in scalable solutions, coupled with robust frameworks for ethical AI usage, will be crucial for maximizing the benefits of these innovations in talent acquisition. Future work should focus on exploring privacy-preserving Machine Learning systems integrated within Blockchain frameworks to enhance data confidentiality. There is also a pressing need to provide standardized protocols for decentralized identity systems and credential verification across organizations. Empirical research with real-world testing will be required to generate practical insights regarding usability and adoption obstacles. To summarize, although Blockchain and Machine Learning provide disruptive prospects for talent acquisition, it is critical to solve current issues through joint research and realistic implementation techniques. By doing so, organizations may create more open, ethical, and inclusive recruiting processes, thereby altering the future landscape of recruitment and talent development.

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