

Original Research Article

Blockchain-based human resources management practices to support performance efficiency: A literature survey

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Abstract: Several studies have discussed the benefits of blockchain in human resources management (HRM) policies to support the efficiency of HRM routine practices in organizations. The discussion ranges from selection and recruitment to employee separation. With the growing interest in digital application usage, research focused on utilization and effective measurement is needed. However, the existing literature review on blockchain-based HRM practices linked to cost efficiency still needs to be improved. Hence, this study aims to review current studies on blockchain human resources management systematically. This study investigates the trends in blockchain application usage in terms of practices, methodologies, and settings. This study used a literature survey and Publish or Perish software with Google Scholar and Scopus as the databases. 123 articles published in 19 journals from 2010 to 2022 were selected. This study used systematic data to reveal trends in HRM practices and qualitative inductive analysis to define relevant themes within the topic. The results show that blockchain applications for efficiency are used mainly in the recruitment and selection process, ranging from personal data verification to the quality of decision-making in skill development and maintenance. Five HRM practices have been discussed, indicating potential explorative and exploitative future research to improve the effectiveness of using blockchain in HRM practices.

Keywords: blockchain; HRM practices; work efficiency; accuracy

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1. Introduction

The fourth industrial revolution (IR 4.0) aims to disrupt business models in various sectors by utilizing digital technology. One of the potential uses of digital technology in today's business world is the application of blockchain technology. The last few decades have shown that the development of blockchain technology has significantly contributed to the business world's progress. One area that feels this technology's positive effect is in the management and organization field, especially human resource management. Human resources are vital assets that produce added value in technology, knowledge, products, and services. The success of a business organization depends on the extent to which it utilizes and adapts the latest available management performance, for example, in the form of reducing the use of resources, time, and cost^[1]. The ability of HRM to increase effectiveness and efficiency will be a source of competitive strength to face the dynamic of the rapid change in the business environment.

Several studies have discussed the benefits that can be taken from the application of blockchain technology for the realization of the effectiveness of HRM practices, for example^[2-4]. Wang et al.^[5] show that

the application of human resource management based on blockchain provides the availability to help make effective decisions. Meanwhile, Hegadekatti^[6] emphasized how the blockchain system adds value for improving human resource management. Furthermore, in terms of HRM practices, blockchain technology also provides convenience in helping the effectiveness of the recruitment and selection process^[7]; emphasizing validation and verification to remove the need for intermediaries^[8,9]; workforce quality through mitigating skills and competencies^[10,11]; and reducing the consumption of resources, time, and cost of the recruitment process^[12–15] blockchain network, verification process, and designed and implemented a Dapp^[15] employee lifecycle^[16] improves education, employment, and skill with an incentive mechanism^[17].

Recent research on using blockchain in human resources to deal with the new normal also states that this technology provides convenience for skill development (training), career management, compensation, and performance management^[18]. At the same time, other studies discuss the advantages of implementing blockchain in the field of human resource management for data strengthening, work contracts, and labour relations^[19,20]. All of these studies point to the potential contribution of blockchain technology to the advancement of HRM. So, research that examines the extent to which the level of use of blockchain is used in HRM efficiency becomes interesting.

The present study aims to investigate blockchain-based HRM applications in terms of cost efficiency and organizational performance. Additionally, the study focuses on the benefits of implementing blockchain-based HRM in organizations and how it influences the sustainable development of companies. Technology and innovation have brought enormous competition to the corporate world, where firms aim to achieve a competitive edge. The second purpose of this study is to review previous studies on the use of blockchain technology in human resource management, either in a theoretical review or already implemented. We used a systematic literature review study on 2010–2022 Scopus articles and 100 articles from Google Scholar related to blockchain-based human resource management.

2. Literature review

2.1. Blockchain technology

Blockchain is related to sharing, decentralization, distribution of ledgers, and tamper-resistant technology, which can help document transactions and track assets on a business network^[21]. “Decentralization” is defined as more than one party or intermediary managing the entire database. However, data or information is stored on multiple host computers over one silo database, which can be very vulnerable to hacking. At a basic level, this technology allows the user community to access shared information securely. Like the internet, blockchain is not owned or controlled by a single individual^[22].

In essence, a blockchain is a “chain” of “blocks”, which means a chain of ordered “blocks” in a network of peers. This chain of blocks is helpful for document validation, entry security, and maintenance of all inputs into the software. A “block” contains data, hashes, and hashes from the previous block, forming a chain-like pattern^[23]. A block can store several different things, such as the amount of money, votes in elections, or data. While “hash” is a value resulting from a string of ext., a hash can be interpreted as equivalent to a fingerprint, so each will give a unique fingerprint as a type of identity to the block. When the data in the block changes, the hash also changes.

From the privacy perspective of blockchain technology, there are several levels, namely fully public, closed to a specific group of users, and hybrid public-private. According to Akgiray^[24], the second type of blockchain is closed to a predetermined group of users, for example, companies, banking communities, or

agents. In a public-private hybrid blockchain, users can see some data fully through private access, but the public can only see part of it. On this type of blockchain, no one can add chains.

Deleting or modifying data once it has been added to a block on the blockchain is impossible because each block is immutable. Blockchain's fundamental concept is based on the conventional understanding of financial ledgers. A user cannot alter data on the blockchain if they want to update it. The intended modifications, however, will be saved in a new block that includes a note about the updated data and the time it was made. The data that has been entered has to be updated for the event or scenario that cannot be avoided. There will be a data route that must be completed. Thanks to blockchain technology, users may soon have access to store, track, and transfer data. Additionally, blockchain technology enables modifications to operational methods, particularly for the efficacy and efficiency of operations in human resource management.

2.2. Blockchain and HRM

At first, blockchain technology was better known only for cryptocurrency and Bitcoin purposes. However, there are predictions that this technology will contribute to all areas of an organization's business. Several recent studies have discussed the role of the development of blockchain technology in the management of an organization, especially for HR. Recent research on the implementation of blockchain technology in HRM has been carried out, for example^[15] (Rhemanda et al.^[25] focusing on the recruitment process system; Chillakuri and Attili^[18] the benefits of blockchain in dealing with the new normal; and Dolzhenko^[20] the use of blockchain for digitizing labour relations. While the study by Nurhasanah et al.^[26] is still limited to developing a blockchain framework for employee performance, their framework has led to blockchain application efforts for HR effectiveness.

Some of these studies have shown a link between the development of blockchain technology and positive and negative effects and barriers to HRM practices, especially for SMEs. It is necessary to conduct a more systematic analysis of some of the most recent literature reviews over a broader period and determine a quality database source. It then limited the literature topics to strategic blockchain applications that can add value to the effectiveness and efficiency of SMEs' HRM practices in an integrated manner.

3. Review methodology

We used a quantitative method with the Publish or Perish (PoP) application from Harzing^[11] to filter relevant articles related to blockchain-based human resource management. This study uses article data from Scopus (2010–2021) and 100 articles from Google Scholar, using key terms such as “blockchain technology” and “human resource management” in the title or keywords. Furthermore, articles that were duplicated in Scopus and Google Scholar and less relevant to the topic of blockchain-based human resource management were eliminated from the analysis. Using the application, 10 articles were obtained from the Scopus database and 13 from the Google Scholar database. The steps of the review methodology can be explained as follows:

- Search strategy: We employed a comprehensive search strategy to identify relevant articles related to blockchain-based HRM. The search was conducted using both the Scopus and Google Scholar databases, covering the period from 2010 to 2021. Key search terms such as “blockchain technology” and “human resource management” were used.
- Data collection: Articles obtained from the search were collected and imported into the Publish or Perish (PoP) application developed by Harzing^[11]. This tool was utilized to manage and filter the articles obtained from both Scopus and Google Scholar databases.

- Screening process: Following the initial search, duplicated articles between Scopus and Google Scholar were removed. Subsequently, articles that were deemed less relevant to the topic of blockchain-based human resource management were eliminated from further analysis. The screening process was conducted based on the relevance of article titles and keywords to the research topic.
- Data extraction: After the screening process, relevant articles from both Scopus and Google Scholar databases were selected for data extraction. Information extracted from each article included author names, titles, publication years, and key findings related to blockchain-based HRM.
- Quality assessment: The quality assessment of the selected articles was conducted based on predetermined criteria, including the relevance of the content to the research topic, the methodological rigor, and the credibility of the findings. Articles meeting these criteria were retained for further analysis.
- Data synthesis: Data synthesis involved organizing and summarizing the key findings from the selected articles into thematic categories. These categories included theoretical perspectives, blockchain application in HRM practices, and advantages and disadvantages of utilizing blockchain technology in HRM.
- Validity and reliability: To ensure the validity and reliability of the findings, a systematic approach was adopted throughout the data collection, screening, extraction, and synthesis processes. This included using established search protocols [Prisma], transparent screening criteria, and standardized data extraction forms.
- Reporting: The findings of the study were reported in accordance with established reporting guidelines for systematic reviews. This involved providing clear and concise summaries of key findings, supported by evidence extracted from the selected articles.

4. Result

From the results of PoP processing, 119 articles were obtained from Scopus and 100 articles from the Google Scholar database. After the elimination of the less relevant articles, there were similarities or duplications in the list of the two sources obtained; 10 articles were obtained from the Scopus database, and 13 articles were obtained from Google Scholar. The exploration results using PoP, based on predetermined criteria, analysis, and summary reviews of several related articles, are shown in **Tables 1** and **2**.

Table 1. Blockchain-based HRM of Scopus database articles.

No.	Author	Title	Content/finding
1.	(Wang et al. ^[5])	Human resource information management model based on blockchain technology	The establishment of HR Information Management based on blockchain provides the effectiveness of supporting information for human-resource decision-making.
2.	(Michaelides ^[7])	The challenges of AI and blockchain on HR recruiting practices	Discuss how blockchain and AI are affecting HR practices; look at hiring practices at firms; discuss employment patterns in the emerging age of high-tech super-automation.
3.	(Hassan Onik et al. ^[8])	A recruitment and human resource management technique using blockchain technology for Industry 4.0	Proposed models, such as validation and verification, can perform better than the existing HRM systems regarding security, cost, time and quality of work.
4.	(Salah et al. ^[3])	Blockchain applications in human resources management: Opportunities and challenge	Examine the results of empirical studies with HRM experts to identify the potential opportunities related to blockchain technology utilization in the HRM domain and the anticipated adoption challenges that may hinder its utilization.

Table 1. (Continued).

No.	Author	Title	Content/finding
5.	(Chillakuri and Attili ^[18])	Role of blockchain in HR's response to new-normal	The study's results identify five use cases to streamline critical processes, helping HR professionals such as certification, skill mapping, payroll processing, data protection and performance management.
6.	(Mishra and Venkatesan ^[4])	Blockchain in human resource management of organizations: an empirical assessment to gauge HR and non-HR perspective	The results revealed no difference in viewpoints of HR and non-HR employees across all contexts related to blockchain to blockchain in HRM.
7.	(Nurhasanah et al. ^[26])	Blockchain-based solution for effective employee management	The proposed blockchain-based solution can facilitate the track record of each employee's performance item, which can be used to develop employee careers.
8.	(Rhemananda et al. ^[25])	Blockchain technology to support employee recruitment and selection in Industrial Revolution 4.0	Develop the concept of blockchain technology application in human resource management, especially in employee recruitment and selection.
9.	(Fachrunnisa and Hussain ^[10])	Blockchain-based human resource management practices for mitigating skills and competencies gap in the workforce	A blockchain-based HRM can help all parties to create a consensus between the needs of the industry with the labour market through the Corporate Training Center as a mediator.
10.	(Ni et al. ^[2])	Behavioral management for employees based on blockchain and smart contracts	Utilizing technological innovations, a combination of social media, smart contracts, and blockchain, produces a model of employee behavior for the availability of trusted data in cyberspace.

Table 2. Blockchain based HRM (BHR) from Google Scholar articles.

No.	Author	Title	Content/finding
1.	(Öncü ^[27])	Software development methodology selection with human resource management approach and a new system design on database: Blockchain application	Blockchain based model is recommended with a new recruitment approach.
2.	(Jain et al. ^[28])	Enhancing training effectiveness for organizations through blockchain-enabled training effectiveness measurement (BETEM)	The BETEM model contributes incrementally toward the complete transformation of employees' training development programs.
3.	(Singla et al. ^[19])	Develop leave application using blockchain smart contract	Developed an intelligent contract architecture design for a Leave Management System using Solidity and Ethereum, a decentralized blockchain application architecture.
4.	(Lukić et al. ^[12])	New job positions and recruitment of employees shaped by blockchain technologies	Blockchain technologies help reduce time and cost consumption in the recruitment process while improving the quality of recruitment as a whole.
5.	(Soules ^[13])	Blockchain technology as a disruptive innovator in human resource management	Blockchain technology provides revolutionary capabilities in HRM operational processes, including recruiting, tracking payroll, training employees, and smart contracts.
6.	(Hegadekatti ^[6])	Blockchain and human resources management	Blockchain systems can add value to HRM
7.	(Sifah et al. ^[1])	BEMPAS: A decentralized employee performance assessment system based on blockchain for intelligent city governance	(BEMPAS) can make an effective decision regarding employee performance with trust, transparency, security and accountability among government workers under a Smart City governing environment.

Table 2. (Continued).

No.	Author	Title	Content/finding
8.	(Lai ^[14])	The application prospects of blockchain technology in human resource management	Blockchain can be helpful in various industries and fields and carry out technical changes and changes to traditional models. Therefore, it is necessary to develop blockchain technology vigorously.
9.	(Pinna and Ibbá ^[29])	A blockchain-based decentralized system for the proper handling of temporary employment contracts	Blockchain creates the necessary trust through the consensus algorithm that rules the peer-to-peer network. In a fair employment relationship, the employer and workers need to guarantee honesty with each other and the formation of mutual trust.
10.	(Dolzhenko ^[20])	Blockchain as an imperative of labor relations digitalizing	Studies show that the implementation/adoption of the blockchain in mass relations requires training for all subjects of economic relations in the basics of the digital economy and IT technologies.
11.	(Lee and Seo ^[15])	A study on implementation of human resource pool recruitment system using blockchain	Propose an implementation plan for the human resource pool recruitment system using private (permitted) blockchain.
12.	(Peisl and Shah ^[16])	The impact of blockchain technologies on recruitment influencing the employee lifecycle.	Blockchain technology provides many benefits, such as decentralized transactions, transparency, immutable records and security.
13.	(Liu et al. ^[17])	Blockchain-based certification for education, employment, and skill with incentive mechanism.	Propose a novel E ² C-Chain, a two-stage blockchain, to improve education, employment, and skill verification systems.

Furthermore, further and specific analysis of the latest fundamental developments in the use of blockchain technology in human resource management practices is presented in **Tables 3** and **4**. The findings from the article review analysis show several main points of blockchain-based HRM development, including (theoretical view opportunities and challenges; blockchain processes in HRM; recruitment practices; HR practices (skill development, compensation, career management, performance management, recruitment and selection; and work contract from HRM effectiveness. Based on the article from the Scopus database, an article was obtained discussing the procedure for using blockchain in Human Resource Information Management (HIRM)^[5]. Blockchain technology is used in recruitment practices; there are two articles^[7,8]. For a theoretical view of the opportunities and challenges of blockchain, there are two articles^[3,4]. Three articles discuss blockchain in HR practices^[9,10,18,26].

Table 3. Reviews of recent developments in blockchain-based HRM in the Scopus database.

No.	Author	Title	Content/finding
1.	(Wang et al. ^[5])	Human resource information management model based on blockchain technology	Discuss the procedures for using blockchain at HRIM
2.	(Michaelides ^[7])	The challenges of AI and blockchain on HR recruiting practices	Recruitment practice
3.	(Hassan Onik et al. ^[8])	A recruitment and human resource management technique using blockchain technology for industry 4.0	Recruitment practice
4.	(Salah et al. ^[3])	Blockchain applications in human resources management: opportunities and challenge	Theoretical view about opportunities and challenge
5.	(Chillakuri and Attili ^[18])	Role of blockchain in HR's response to new-normal	HR Practices: skill development, compensation, performance management

Table 3. (Continued).

No.	Author	Title	Content/finding
6.	(Mishra and Venkatesan ^[4])	Blockchain in human resource management of organizations: an empirical assessment to gauge HR and non-HR perspective	Theoretical view about opportunities and challenges
7.	(Nurhasanah et al. ^[26])	Blockchain-based solution for effective employee management	HR Practices: Career Management, Performance Management
8.	(Rhemananda et al. ^[25])	Blockchain technology to support employee recruitment and selection in Industrial Revolution 4.0	HR Practices: Recruitment and selection
9.	(Fachrunnisa and Hussain ^[10])	Blockchain-based human resource management practices for mitigating skills and competencies gap in the workforce	HR Practices: Recruitment, skill development
10.	(Ni et al. ^[2])	Behavioral Management for Employees based on Blockchain and Smart Contracts	Work contract for Effectiveness HRM

Table 4. Reviews of recent developments in blockchain-based HRM in the Google Scholar database.

No.	Author	Title	Content/Finding
1.	(Öncü ^[27])	Software development methodology selection with human resource management approach and a new system design on database: Blockchain application	HR Practice: Recruitment
2.	(Jain et al. ^[28])	Enhancing training effectiveness for organizations through blockchain-enabled training effectiveness measurement (BETEM)	HR Practice: Training (skill development)
3.	(Singla et al. ^[19])	Develop leave application using blockchain smart contract	HR Practice: Leave Management System (Employee Data Management)
4.	(Lukić et al. ^[12])	New job positions and recruitment of employees shaped by blockchain technologies	HR Practise: Recruitment
5.	Soules ^[13]	Blockchain technology as a disruptive innovator in human resource management	HR Practice: Recruitment, compensation, training
6.	(Hegadekatti ^[6])	Blockchain and human resources management	Theoretical view: benefits of using blockchain
7.	(Sifah et al. ^[11])	BEMPAS: A decentralized employee performance assessment system based on blockchain for smart city governance	HR Practice: Employee Performance
8.	(Lai ^[14])	The application prospects of blockchain technology in human resource management	HR Practice: Recruitment and Selection
9.	(Pinna and Ibba ^[29])	A blockchain-based decentralized system for proper handling of temporary employment contracts	HR Practice: work contract
10.	(Dolzhenko ^[20])	Blockchain as an imperative of labor relations digitalizing	HR Practice: Labor Relations
11.	(Lee and Seo ^[15])	A study on implementation of human resource pool recruitment system using blockchain	HR Practice: Recruitment
12.	(Peisl and Shah ^[16])	The impact of blockchain technologies on recruitment influencing the employee lifecycle	HR Practice: Recruitment
13.	(Liu et al. ^[17])	Blockchain-based certification for education, employment, and skill with incentive mechanism	HR Practice: Recruitment and Selection

Meanwhile, findings from the Google Scholar database show that most of the use of blockchain in HR practices includes recruitment and selection, compensation, training (skill development), work contracts, and labour relations. While the rest of the article discusses the theoretical view of the benefits of using blockchain^[6].

5. Discussion

5.1. Utilization of blockchain technology in HRM practices

From the various findings of the literature review, analysis highlighting the use of blockchain technology has been developed in HRM practices as follows:

a. Recruitment

Several studies that have discussed the use of blockchain in recruitment include^[7–10,12,13,15–17,27]

b. Rewarding

The implementation of blockchain-related rewards, including payment and compensation, has been carried out by^[13,18].

c. Performance Management

Blockchain technology is also helpful in improving performance management, for example, helping HR professionals in terms of certification, skill mapping and data protection^[18]; track record of employee performance^[26]; and employee performance^[1].

d. Work Contract

Regarding work contracts, blockchain technology has made it easy for smart contracts, for example, through the innovative contract model of HRIM^[5]; employee data management (a leave management system using smartphones as it devices)^[19]; labour relations^[20]. D-ES and DLT in a blockchain-based decentralized system, able to facilitate a fair employment relationship, employer and workers need to guarantee honesty with each other and the formation of mutual trust^[2,29].

e. Training and Skill Development

Blockchain technology has also been used in training and development^[18] and in career management^[26]. More broadly, the study^[10] explains that blockchain technology can build a quality workforce competency improvement, create consensus between industry (employers) and labour (employees) through the Corporate Training Center as a mediator to process the information and data needed by each party so that the connection between parties will be assisted efficiently and effectively.

5.2. The application of blockchain to human resource practice

Blockchain technology has emerged as a promising tool for revolutionizing HRM practices across various domains. This discussion synthesizes the findings from a systematic review of literature on the application of blockchain in HRM, highlighting its potential benefits, challenges, and areas for further exploration.

5.2.1. Recruitment application

Recruitment stands as one of the fundamental pillars of Human Resource Management (HRM), and the integration of blockchain technology has introduced transformative changes in this domain. The inclusion of blockchain in the recruitment process offers a myriad of benefits, ranging from enhancing transparency to improving the efficiency and security of candidate selection. The discussion below delves into the implications of utilizing blockchain in recruitment practices, drawing insights from various scholarly studies.

Enhances transparency and trust

The adoption of blockchain technology in recruitment, as highlighted by several studies^[7–10,12–16,27] brings forth enhanced transparency and trust in the hiring process. Blockchain's decentralized nature ensures that candidate credentials and qualifications are securely stored and verified on an immutable ledger, eliminating the risk of data manipulation or fraud. This transparency instills trust among stakeholders, including both employers and candidates, fostering a more reliable and credible recruitment ecosystem.

Streamlined verification processes

Blockchain technology streamlines the verification processes inherent in recruitment, facilitating seamless and efficient candidate screening. By storing candidate credentials, qualifications, and employment history on a blockchain ledger, recruiters can access verified information instantaneously, eliminating the need for time-consuming manual verification processes. This expedited verification not only accelerates the recruitment timeline but also reduces administrative overhead, allowing HR professionals to focus on more strategic aspects of talent acquisition.

Data security and privacy

Data security and privacy are paramount considerations in recruitment, and blockchain technology offers robust solutions in this regard. The cryptographic principles underlying blockchain ensure the integrity and confidentiality of candidate data, safeguarding sensitive information from unauthorized access or tampering. Moreover, blockchain's decentralized architecture mitigates the risk of single points of failure, enhancing the resilience of recruitment systems against cyber threats and data breaches.

Cost reduction and efficiency

The adoption of blockchains in recruitment contributes to cost reduction and operational efficiency by eliminating intermediaries and redundant processes. Traditional recruitment processes often involve third-party verification services or background check providers, which incur additional costs and introduce delays. By leveraging blockchain for candidate verification and credentialing, organizations can bypass these intermediaries, reducing costs and streamlining recruitment workflows.

The integration of blockchain technology into recruitment practices represents a significant advancement in the field of HRM. The adoption of blockchain offers unparalleled transparency, trust, and efficiency in candidate selection while simultaneously enhancing data security and privacy. Moving forward, organizations that embrace blockchain in recruitment stand to gain a competitive advantage in attracting top talent and optimizing HR processes.

Recommendation for implementations

1. Organizations should conduct thorough assessments of their existing recruitment processes to identify areas where blockchain technology can add value.
2. Collaboration with blockchain technology providers and experts is essential to ensuring the successful integration and implementation of blockchain-based recruitment solutions.
3. Continuous monitoring and evaluation of blockchain-based recruitment systems is necessary to address any challenges and optimize performance over time.

5.2.2. Rewarding application

The application of in Human Resource Management (HRM) extends beyond traditional functions like recruitment to encompass rewarding systems, including payment and compensation. Leveraging blockchain

in rewarding practices introduces novel approaches to incentivizing and compensating employees, offering benefits such as enhanced transparency, security, and efficiency. The following discussion examines the implications of utilizing blockchain in rewarding practices, drawing insights from scholarly studies.

Enhanced Transparency and Accountability

The implementation of blockchain-related rewards, as demonstrated by studies conducted by Chillakuri and Attili^[18] and Soules^[13], brings forth enhanced transparency and accountability in rewarding practices. Blockchain's immutable ledger ensures that all transactions related to rewards, including payment and compensation, are securely recorded and traceable. This transparency fosters trust among employees, as they can independently verify the accuracy and fairness of reward distributions.

Secured Transactions and Data Integrity

Blockchain technology provides a secure and tamper-proof environment for reward transactions, safeguarding against unauthorized alterations or fraud. Each transaction recorded on the blockchain is cryptographically encrypted and linked to previous transactions, making it virtually impossible to alter historical data without detection. This inherent security feature ensures the integrity of reward transactions, mitigating the risk of data manipulation or unauthorized access.

Efficient Reward Distribution

Blockchain streamlines the process of reward distribution by automating and digitizing reward mechanisms. Smart contracts, programmable self-executing contracts deployed on blockchain networks, enable the automatic execution of reward agreements based on predefined conditions. This automation eliminates the need for manual intervention in reward distribution, reducing administrative overhead and streamlining the rewarding process for HR professionals.

Decentralized Reward Systems

Blockchain facilitates the creation of decentralized reward systems, where rewards are distributed based on predefined criteria without the need for centralized intermediaries. By decentralizing reward systems, blockchain empowers employees with greater control and autonomy over their rewards, fostering a sense of ownership and fairness. Moreover, decentralized reward systems promote inclusivity and diversity by ensuring equitable distribution of rewards across the organization.

The integration of blockchain technology in rewarding practices represents a paradigm shift in HRM, offering unprecedented transparency, security, and efficiency in reward management. By leveraging blockchain, organizations can establish trust-based reward systems that enhance employee engagement, motivation, and satisfaction. Moving forward, the adoption of blockchain in rewarding practices holds the potential to revolutionize traditional approaches to compensation and innovation, driving organizational performance and employee retention.

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Recommendation for Implementation

1. Organizations should assess their existing rewarding systems to identify areas where blockchain technology can add value, such as enhancing transparency or reducing administrative load.
2. Collaboration with blockchain technology providers and experts is essential to designing and deploying blockchain-based, rewarding solutions tailored to the organization's specific needs and objectives.
3. Employee education and training on blockchain technology and its implications for rewarding practices are crucial to ensuring successful adoption and acceptance within the organization.

5.2.3. Performance management application

The utilization of blockchain technology in Performance Management within HRM practices offers a range of benefits, from enhancing data integrity and transparency to facilitating more accurate and efficient evaluation processes. Examining the implications of blockchain in performance management, as evidenced by studies conducted by Chillakuri and Attili^[18], Nurhasanah et al^[26], and Sifah et al.^[1], sheds light on its transformative potential in this critical aspect of HRM.

Enhanced data integrity and security

Blockchain technology ensures the integrity and security of performance-related data by leveraging its immutable ledger. Through blockchain, performance data, including certifications, skill mapping, and employee track records, can be securely recorded and accessed in a tamper-proof manner. This not only enhances data accuracy but also safeguards against unauthorized alterations or falsifications, thereby instilling trust in the performance evaluation process.

Transparent evaluation processes

By leveraging blockchain for performance management, organizations can establish transparent and auditable evaluation processes. The transparent nature of blockchain ensures that performance-related transactions and evaluations are recorded on a shared ledger accessible to relevant stakeholders. This transparency fosters accountability and fairness in performance assessments, as both employees and management have visibility into the criteria and outcomes of evaluations.

Efficient performance tracking and monitoring

Blockchain facilitates efficient tracking and monitoring of employee performance by providing real-time access to performance data. Through blockchain-based systems, HR professionals can maintain comprehensive records of employee performance, enabling timely interventions and feedback. This real-time tracking enhances agility in performance management, allowing organizations to identify and address performance issues promptly.

Decentralized performance evaluation

Blockchain enables decentralized performance evaluation systems, where performance assessments are conducted based on predefined criteria without the need for centralized oversight. Decentralized evaluation processes empower employees with greater autonomy and ownership over their performance, fostering a culture of self-accountability and continuous improvement. Moreover, decentralized systems promote objectivity and fairness in performance evaluations by reducing biases and subjective judgments.

The integration of blockchain technology in Performance Management represents a significant advancement in HRM, offering enhanced data integrity, transparency, and efficiency in performance evaluation processes. By leveraging blockchain, organizations can establish trust-based performance management systems that promote fairness, accountability, and employee development. Moving forward, the

adoption of blockchain in performance management holds the potential to revolutionize traditional approaches to performance evaluation, driving organizational effectiveness and employee engagement.

Recommendation for implementation

a) Organizations should assess their existing performance management systems to identify areas where blockchain technology can add value, such as enhancing data integrity or streamlining evaluation processes.

b) Collaboration with blockchain technology providers and experts is essential to design and implement blockchain-based performance management solutions tailored to the organization's specific needs and objectives.

c) Employee training and communication on blockchain technology and its implications for performance management are crucial to ensure successful adoption and acceptance within the organization.

5.3. Advantages of blockchain technology in HRM

Enhanced trust and transparency: One of the key advantages of blockchain technology in HRM is its ability to provide a transparent and tamper-proof ledger system. By leveraging decentralized consensus mechanisms and cryptographic techniques, blockchain ensures data integrity and security, thereby enhancing trust among HRM stakeholders, including employers, employees, and HR professionals.

Efficiency and Streamlined Processes: Blockchain facilitates the automation of routine HR tasks through smart contracts, reducing the need for intermediaries and streamlining processes such as recruitment, payroll management, and performance evaluation. This efficiency leads to cost savings, time optimization, and improved overall operational effectiveness in HRM.

Disruptive innovation: Blockchain serves as a disruptive innovator in HRM by enabling the transformation of traditional practices. It offers revolutionary capabilities in various operational processes, including recruiting, tracking payroll, training employees, and enforcing smart contracts. By embracing blockchain, organizations can adapt to the evolving landscape of HRM in the digital age.

Data protection and cybersecurity: With cryptographic security features and a decentralized architecture, blockchain technology offers robust protection against data breaches and cyberattacks. By storing data across a distributed network of nodes, we ensure the confidentiality and integrity of HR-related information.

Facilitated Decision Making: Blockchain technology facilitates easier decision-making processes in HRM by providing real-time access to accurate and immutable data. HR professionals can make informed decisions based on trustworthy information stored on the blockchain, leading to more effective workforce management and strategic planning.

5.4. Challenges and limitations of blockchain in HRM

Performance and speed: Despite its numerous advantages, blockchain technology faces challenges related to performance and speed. The verification and consensus mechanisms inherent in blockchain transactions can result in slower processing times compared to traditional databases. Additionally, scalability issues may arise when handling a large volume of transactions, impacting overall system performance.

High implementation costs: The implementation of blockchain technology in HRM requires significant investment in terms of both financial resources and technical expertise. Businesses must carefully plan and execute the integration of blockchain into their HR processes, considering factors such as infrastructure costs, training, and ongoing maintenance expenses.

Data Modification Challenges: Data recorded on the blockchain is immutable, meaning that once a transaction is confirmed, it cannot be easily modified or deleted. While this feature ensures data integrity and prevents tampering, it also poses challenges when errors need correction or updating. Modifying data on the blockchain can be complex and time-consuming, involving rewriting codes in each block.

5.5. Future direction and recommendations

While the existing literature demonstrates the potential of blockchain technology in various HRM practices such as recruitment, rewarding, performance management, and training, there remain several areas for further exploration and research. Specifically, future studies should focus on:

- **Strategic integration of blockchain:** Investigate the strategic implications of integrating blockchain technology into core HRM functions to enhance organizational competitiveness and agility.
- **Expansion Beyond Recruitment:** Exploring the broader applications of blockchain in HRM beyond recruitment and selection, including strategic workforce planning, talent development, and succession management.
- **Decision Support System:** Developing blockchain-based decision support systems that leverage the transparency and reliability of blockchain data to facilitate informed decision-making in HRM.
- **Interdisciplinary Collaboration:** Encouraging interdisciplinary collaboration between HRM experts, blockchain developers, and industry practitioners to co-create innovative solutions that address the evolving needs of the workforce.

While blockchain technology holds immense potential for transforming HRM practices, its effective implementation requires careful consideration of both its benefits and challenges. By addressing these challenges and exploring new avenues for research and collaboration, organizations can harness the full potential of blockchain to drive innovation and excellence in HRM. **Figure 1** summarizes our findings and discussion.

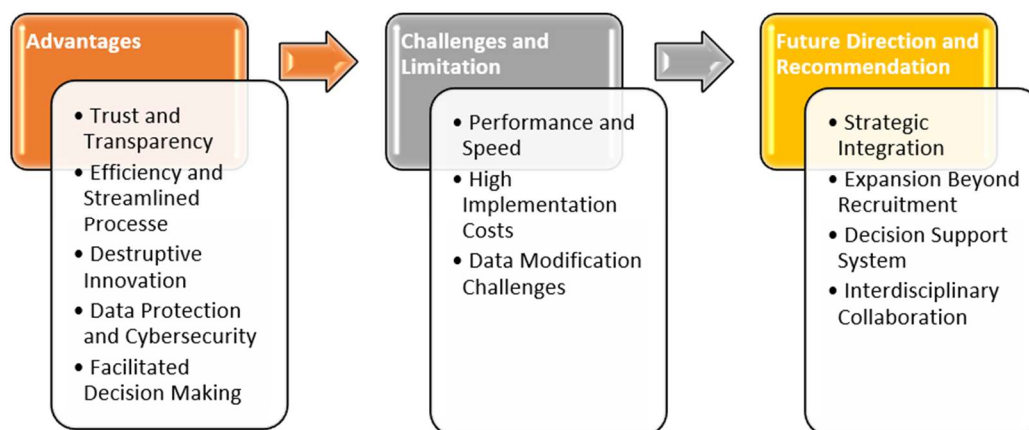


Figure 1. Findings and discussions.

6. Conclusion, limitation and future research

This study aims to review previous studies to determine the use of blockchain technology to support HRM practices. The development of blockchain technology for HRM practices will continue to be an exciting study area. A systematic review analysis of several articles from Scopus and the Google Scholar database shows several main points of blockchain implementation developed in HR practices, including recruitment,

rewarding, performance management, work contracts, and training and development. In addition, although it is still theoretical, the results of our review also discuss the negative and positive sides of blockchain technology, especially in HR practices. From these findings, future research should pay attention to how blockchain technology manages information, becoming relevant knowledge to facilitate decision-making on HR practices (recruitment, rewarding, performance management, work contracts, as well as training and development) in a more integrated manner.

Author contributions

Conceptualization, OF; methodology, OF, AA, and N; software, OF; validation, OF, AA, and N; formal analysis, OF; investigation, OF; resources, AA; data curation, N; writing—original draft preparation, OF; writing—review and editing, OF; visualization, N; supervision, OF; project administration, OF; funding acquisition, OF, AA, and N. All authors have read and agreed to the published version of the manuscript.

Conflict of interest

The authors declare no conflict of interest.

References

1. Sifah EB, Xia H, Cobblah CNA, et al. BEMPAS: A decentralized employee performance assessment system based on blockchain for smart city governance. *IEEE Access* 2020; 8: 99528–99539. doi: 10.1109/access.2020.2997650
2. Ni X, Yuan Y, Wang FY. Behavioral management for employees based on blockchain and smart contracts. In: Proceedings of the 2019 IEEE International Conference on Service Operations and Logistics, and Informatics (SOLI); 6–8 November 2019; Zhengzhou, China. pp. 5–9. doi: 10.1109/soli48380.2019.8955008
3. Salah D, Ahmed MH, Eldahshan K. Blockchain applications in human resources management: Opportunities and challenges. In: Proceedings of the Evaluation and Assessment in Software Engineering; 15–17 April 2020; Trondheim, Norway. doi: 10.1145/3383219.3383274
4. Mishra H, Venkatesan M. Blockchain in human resource management of organizations: an empirical assessment to gauge HR and non-HR perspective. *Journal of Organizational Change Management* 2021; 34(2): 525–542. doi: 10.1108/jocm-08-2020-0261
5. Wang X, Feng L, Zhang H, et al. Human resource information management model based on blockchain technology. In: Proceedings of the 2017 IEEE Symposium on Service-Oriented System Engineering (SOSE); 6–9 April 2017; San Francisco, CA, USA. doi: 10.1109/sose.2017.34
6. Hegadekatti K. Blockchain and human resources management. Available online: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3232203 (accessed on 16 May 2022).
7. Michaelides M. The challenges of AI and blockchain on HR recruiting practices. *Cyprus Review* 2018; 30(1): 169–180.
8. Hassan Onik M, Miraz MH, Kim CS. A recruitment and human resource management technique using blockchain technology for Industry 4.0. In: Proceedings of the Smart Cities Symposium 2018; 22–23 April 2018; Zallaq, Bahrain. doi: 10.1049/cp.2018.1371
9. Pattnaik PK, Sain M, Al-Absi AA, Jumar P (editors). *Proceedings of International Conference on Smart Computing and Cyber Security*. Springer; 2021. doi: 10.1007/978-981-15-7990-5
10. Fachrunnisa O, Hussain FK. Blockchain-based human resource management practices for mitigating skills and competencies gap in workforce. *International Journal of Engineering Business Management* 2020; 12: 184797902096640. doi: 10.1177/184797902096640
11. Harzing. Adams D. Available online: <https://harzing.com/.author/david.adams> (accessed on 10 May 2022).
12. Lukić J, Salkić H, Ostojić B. New job positions and recruitment of employees shaped by blockchain technologies. In: Proceedings of the Fourth International Scientific Business Conference LIMEN 2018; 13 December 2018; Belgrade, Serbia. pp. 314–320. doi: 10.31410/limen.2018.314
13. Soules C. Blockchain technology as a disruptive innovator in human resource management. Available online: <https://digitalcommons.sacredheart.edu/acadfest/2020/all/22/> (accessed on 10 May 2022).
14. Lai J. The application prospects of blockchain technology in human resource management. *Modern Management Forum* 2020; 4(4): 167. doi: 10.18686/mmfv4i4.2782
15. Lee JW, Seo HS. A study on implementation of human resource pool recruitment system using blockchain. *Journal of The Korea Society of Computer and Information* 2021; 26(2): 67–78. doi: 10.9708/jksci.2021.26.02.069

16. Peisl T, Shah B. The impact of blockchain technologies on recruitment influencing the employee lifecycle. In: Walker A, O'Connor R, Messnarz R (editors). *Systems, Software and Services Process Improvement*, Proceedings of the 26th European Conference, EuroSPI 2019; 18–20 September 2019; Edinburgh, UK. Springer; 2019. doi: 10.1007/978-3-030-28005-5_54
17. Liu L, Han M, Zhou Y, et al. Blockchain-based certification for education, employment, and skill with incentive mechanism. In: Choo KK, Dehghantanha A, Parizi R (editors). *Blockchain Cybersecurity, Trust and Privacy*. Springer; 2020. Volume 79. pp. 269–290. doi: 10.1007/978-3-030-38181-3_14
18. Chillakuri B, Attili VSP. Role of blockchain in HR's response to new-normal. *International Journal of Organizational Analysis* 2021; 30(6): 1359–1378. doi: 10.1108/ijoa-08-2020-2363
19. Singla V, Malav IK, Kaur J, et al. Develop leave application using blockchain smart contract. In: Proceedings of the 2019 11th International Conference on Communication Systems & Networks (COMSNETS); 7–11 January 2019; Bengaluru, India. doi: 10.1109/comsnets.2019.8711422
20. Dolzhenko R. Blockchain as an imperative of labor relations digitalizing. *SHS Web of Conferences* 2021; 93: 01010. doi: 10.1051/shsconf/20219301010
21. Yaga D, Mell P, Roby N, Scarfone K. *Blockchain Technology Overview*. National Institute of Standards and Technology; 2018. doi: 10.6028/nist.ir.820
22. Matoria M. Who owns the blockchain? How democratic is the decentralization? Available online: <https://mohitmatoria.medium.com/who-owns-the-blockchain-9b3af7a2ab76> (accessed on 10 May 2022).
23. Crosby M, Nachiappan, Pattanayak P, et al. Blockchain technology: Beyond bitcoin. *Applied Innovation Review* 2016; 2: 71.
24. Akgiray V. *Blockchain Technology and Corporate Governance: Technology, Markets, Regulation, and Corporate Governance*. Organisation for Economic Co-operation and Development; 2018.
25. Rhemananda H, Simbolon DR, Fachrunnisa O. Blockchain technology to support employee recruitment and selection in Industrial Revolution 4.0. In: Pattnaik PK, Sain M, Al-Absi AA, Kumar P (editors). *Proceedings of International Conference on Smart Computing and Cyber Security: Strategic Foresight, Security Challenges and Innovation (SMARTCYBER 2020)*. Springer; 2021. Volume 149. pp. 305–311. doi: 10.1007/978-981-15-7990-5_30
26. Nurhasanah Y, Prameswari D, Fachrunnisa O. Blockchain-based solution for effective employee management. In: Pattnaik PK, Sain M, Al-Absi AA, Kumar P (editors). *Proceedings of International Conference on Smart Computing and Cyber Security: Strategic Foresight, Security Challenges and Innovation (SMARTCYBER 2020)*. Springer; 2021. Volume 149. pp. 147–154. doi: 10.1007/978-981-15-7990-5_14
27. Öncü K. Software development methodology selection with human resource management approach and a new system design on database: Blockchain application. *Quarade Journal of Complex System in Social Sciences* 2019; 1(1): 28–39.
28. Jain G, Sharma N, Shrivastava A. Enhancing training effectiveness for organizations through blockchain-enabled training effectiveness measurement (BETEM). *Journal of Organizational Change Management* 2021; 34(2): 439–461. doi: 10.1108/JOCM-10-2020-0303
29. Pinna A, Ibba S. A blockchain-based decentralized system for proper handling of temporary employment contracts. In: Arai K, Kapoor S, Bhatia R (editors). *Intelligent Computing: Proceedings of the 2018 Computing Conference*. Springer; 2019. Volume 2. pp. 1231–1243. doi: 10.1007/978-3-030-01177-2_88