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# Blockchain as a Catalyst for Green and Digital HR Transformation: Strategies for Sustainable Workforce Management

**Submitted by:**

*Dr. Zohaib Azhar*

**EIU400068**

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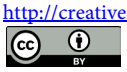
**Zohaib Azhar**[1,2,3*]

[1]European International University, Paris, France
[2]Charisma University, Turks and Caicos Islands
[3]Society for Human Resource Management, Alexandria, VA, USA
Email: Zohaib.azhar@outlook.com

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## Abstract

Many general practices of HR are being transformed by blockchain and are being turned into efficient, progressive strategies. This paper aims to understanding how blockchain can support green and digital transformation of HR emphasizing sustainable workforce management. Blockchain strengthens the protection of information, and at the same time, makes the process more transparent and with less impact on the environment in terms of HR activities. But embracing blockchain in HRM also has its own limitations, for example, technical and legal concerns as well as the challenges in altering HRM. Blockchain in HR implies the HR use of decentralized technology that can provide enhancement in the storage and management of information. It improves data security since, during employment, records and pay stubs are sealed and can only be accessed by administrative HR officers. Transparent approach is also achieved by storing all the HR transactions on a chain that is easily availed for audit, hence creating accountability. However, it also complements these tasks through automation and smart contracts that eliminate the need for paperwork and in Human resource. Blockchain is another green HR transformation that encourages paperless working, energy-efficient business models, and environmentally friendly recruitment. In digital HR, it enables securing of talent management, managing of payroll and compensation, and learning and development. However, addressing all these challenges that come with implementing blockchain in HR is another challenge. For any organization to implement the blockchain solutions, must have the technical know-how of the implementation, to meet all the legal requirements, and meant to deal with the cultural

*Doctor of Business Administration (DBA) & Specialization in HR of Affiliation 1; PhD in Business Administration of Affiliaition 2; SHRM-SCP of Affiliation 3; Chartered Professional in Human Resources, Vancouver, Canada.

transformation that the solutions will bring about. Those areas include stakeholder management, pilot projects and the commitment to the integration of blockchain into existing processes as well as the improvement of this process over time. In conclusion, blockchain is the most secure, efficient, and environmentally friendly tools for HR management. Thus, if implementation issues are solved and if furthermore strategical approaches are applied, blockchain offers the greatest potential for organizations to work better and more effective for the human resources in the future.

## Subject Areas

Business Management

## Keywords

Blockchain, HR Management, Sustainable Workforce Management

## 1. Introduction

Indeed, in the contemporary world, discussed in the context of the significant rate of changes in global business environments, the tendencies toward sustainability and digitalization are of particular importance for companies that would like to have competitiveness and address the requirements of society. The last resource for any organization, people, makes the HR profession spearhead this transformation as it is the keeper of the organization's most important asset. Today's HR departments are required to embark on practices that optimize organizational functions and employee satisfaction while at the same time improving the environment and society.

The desire towards sustainability has arisen due to emerging demands concerning environmental pollution, climate change, and the increasing scarcity of natural resources. Currently, shareholders, consumers, and government agencies are putting pressure on the organization to prove it is environmentally responsible. For HR, this signifies the incorporation of environmental conservation activities into the normal duties of the organization through the elimination of the use of paper and low energy, among other things, and the need to teach the employees how to be environmentally conscious. Green HR transformation is not only about facility management but also about changing people's mindsets throughout the organization.

Digital HRM is focused on upholding the potency and capability of sophisticated technologies in supporting the delivery of HRM services, process reformation, and the creation of unique value. Tools like artificial intelligence, machine learning, and big data analytics are already being used to transform traditional areas of HR. This includes enhancing sources for getting more suitable employees, methods for successfully assimilation of new employees within the organization's cultures and climate to achieve enhanced performance management, and

employee training and development. Thus, HR is primarily focused on digitalization, not only to become more efficient but also to ensure the quality of employees' experiences.

## 1.1. What Is the Role of Blockchain in HR Transformation?

Blockchain technology, which came into the limelight with cryptocurrencies such as bitcoins, has enormous potential beyond the confines of the financial domain. This is a distributed database that avoids central control and checks, wherein operations take place across different connected computers, and the report of the transaction cannot be changed later. Thus, inherent to the nature of blockchain is its potential to become a valuable tool for the reinvention of HR practices by providing security, improving the level of transparency, and implementing the process of automation [1] [2].

### 1.1.1. For HR, Blockchain Can Provide Several Transformative Benefits

1) Data Security: In terms of security, Blockchain's applications guarantee that information, including records of employment and employees' payroll, is immutable and safe from hacking since it is encrypted with cryptographic algorithms.

2) Transparency: The information being stored in the blockchain is all the transactions that can be accessed by some participants, and once these transactions are validated, they cannot be changed further, which helps to maintain integrity in the HR processes.

3) Efficiency: HR functions, including payroll and benefits administration, can all be automated with smart contracts on the blockchain, which would considerably cut down on the workload.

### 1.1.2. Possible Uses of Blockchain in Green and Digital HR

**Green HR Transformation:**

1) Paperless Operations: Through digitization of employees' records, contracts, and other working documents through creating a decentralized workspace on the blockchain, organizations are likely to implement paperless human resource management, which will help cut down on the number of papers used.

2) Energy Efficiency: It is therefore not surprising that optimizing HR processes using blockchain can help reduce energy consumption significantly compared to the normal traditional process.

3) Sustainable Recruitment: The use of blockchain eliminates the use of paper-based credentials and physical processing for certification, thereby reducing the discharge of greenhouse gases in the recruitment process.

**Digital HR Transformation:**

1) Enhanced Data Security and Privacy: Blockchain can safeguard HR data and prevent data privacy violations, which are crucial in protecting the institution's reputation among the employees and fulfilling governmental regulations.

2) Improved Transparency and Accountability: This concept makes HR practices more credible as any activity in this area is constantly documented on the

blockchain, which can be checked at any time.

3) Streamlined Talent Management: Blockchain, on the one hand, can help develop a single platform for tracking all the records of employees, their performance at work or ratings, and their career paths, thereby making HR processes more resourceful.

4) Automated Payroll and Compensation: payroll processing could be one of those applications where blockchain could bring the best of its features, such as real-time, secure, and transparent transactions for timely and accurate payroll, while at the same time reducing the much-needed overhead of handling the paperwork.

### 1.2. Purpose of the Paper and Strategic Organization

This paper's objective is to give an analysis of how blockchain can help in the green and digital HR transformation. It also investigates the probable advantages of blockchain application in workforce sustainability and practical solutions for its proper employment. The paper is structured as follows:

1) Understanding Blockchain Technology: Explaining, particularly for HR, what blockchain is, its basic global characteristics, and general tendencies.

2) Blockchain and Green HR Transformation: This paper seeks to identify how blockchain can enhance environmentally sustainable HRM practices.

3) Blockchain and Digital HR Transformation: A Paper Examining Blockchain as the Next Step in the Digitization of HR Organizational Processes.

4) Strategies for Implementing Blockchain in HR: Strategies that the organization can implement to use blockchain in sustainable HR management.

5) Challenges and Considerations: Information on the difficulties that individual organizations have encountered while using blockchain in the realm of HR and methods of how such issues can be mitigated.

Thus, the paper discusses these aspects to offer useful recommendations for professionals in the field of HR and managers who are willing to develop their organizations to adopt blockchain technology in HR practice.

## 2. Understanding Block Chain Technology

Blockchain technology, on which such phenomena as Bitcoin are based, was originally considered to have an array of diverse applications in certain fields. Being based on concepts such as decentralization, transparency, and security, blockchain is a revolutionary technology that can greatly improve HR practices. This section gives a detailed description of blockchain, its characteristics, and how it is applied to HR.

### 2.1. Overview of Blockchain Technology

Blockchain is an open distributed ledger rapidly growing in popularity as a distributed database to store and modify a record of digital exchange. Every transaction is contained within a block, and these are connected chronologically, resulting

in a sequence that is referred to as the block chain. This structure makes it almost impossible for any data that is recorded in any block to be changed without having to change the subsequent blocks, and this again would require the consensus of the network [3].

Key Features of Blockchain

#### 2.1.1. Decentralization

The traditional databases can also be termed centralized because they are mostly governed by an authority. Blockchain, on the other hand, works on a peer-to-peer system where every participant or node holds a copy of the blockchain. This decentralization removes the dependability on a particular person or a group of people, which can lead to a failure in the system [4].

#### 2.1.2. Transparency and Immutability

Currently, each of the transactions made on the blockchain database is accessible to recognized individuals. After creating a block, it is linked to the previous and subsequent blocks, thus making the data in the block unable to be modified or deleted. Such openness and unchangeability provide data credibility and increase participants' trust because everything that takes place can be traced [3]

#### 2.1.3. Security

Basically, blockchain employs complex algorithms to secure data, which is one of the features of this technology. Every block implements the hash of the previous block, the date when it was created, and the data of the transactions. During the hashing process, there is a guarantee that even a slight change in the data will change the hash, thereby detecting an attempt at tampering [5]. *Blockchain technology*: *Beyond bitcoin*. *Applied Innovation Review*, *2*, *6-19*. Besides, blockchain is more secure than traditional databases, as its structure is based on nodes, and the changing of one node does not impact the others.

#### 2.1.4. Smart Contracts

Smart contracts are agreements that operate autonomously or on their own, with the conditions of the contract written in the code. When certain conditions are fulfilled, they are self-activating and self-executive, thus eliminating the middlemen. The following are some of the possible applications of smart contracts in the HR department: payroll, benefits, and compliance.

### 2.2. Blockchain and HR: The Place of Blockchain in HR

Explaining some of the features of blockchain, one can note the advantages it holds for the HR field as it turns existing processes into more protected, clear, and effective procedures. Here are several key areas where blockchain can make a significant impact.

#### 2.2.1. Data Security and Privacy

HR departments deal with people's data, such as personal data, employment

records, and payrolls. To this, we add that, due to the cryptographic nature of blockchain technology, this data is sealed and encrypted to prevent interference by unauthorized parties. This is even more so because decentralization gets rid of concentrations of vulnerability that can be such a target.

#### 2.2.2. Transparency and Accountability

Blockchain entails a continuous record of all HR transactions, including hiring decisions, performance appraisals, and promotions, among others. This makes the system accountable within the organization since anything that is done is recorded, with archived data being retrievable by anyone who is empowered to do so.

#### 2.2.3. Efficiency and Automation

One of the advantages of using smart contracts in HR is that certain HR functions can be easily automated, thus decreasing the workload. For instance, the organization payroll can work automatically depending on the set parameters, so the workers will receive timely and accurate payments without regard to excessive human interference.

#### 2.2.4. Credential Verification

It is very exhaustive and, at times, phenomenally tedious to confirm the details submitted by candidates. This can be made easier using blockchain, whose features offer a secure way of documenting academic achievements, certifications, and experience. Besides, it shortens the time for recruitment and reduces the probability of false declarations.

#### 2.2.5. Talent Management

By applying the concept of blockchain, employee records, performance, and development data are thought to be stored in a single system with high security. This integrated picture makes the work of HR more efficient by providing information that will help to make the right decisions about promotions, training, and development activities.

### 2.3. Practical Applications in HR

#### 2.3.1. Recruitment and Onboarding

Blockchain can also be adopted in recruitment; for example, it can be used to validate an employee and store the credentials on the block chain. This minimizes the grounds for verifying the candidate's background and fastens the process of his or her onboarding.

#### 2.3.2. Payroll and Benefits Administration

Payroll is another area where smart contracts can come into play, making sure that the correct computation for salaries is made and that employees receive what is due to them at the right time as per certain set standards. Another function that can be addressed through the implementation of benefit administration is automatic processing, which eliminates overhead and mistakes.

#### 2.3.3. Performance Management

In performance monitoring and appraisal, records and assessments can be permanently stored on the blockchain, hence creating an unalterable record of the employee's records. This makes the performance management process more credible and any form of evaluation more accurate.

#### 2.3.4. Compliance and Audit

Blockchain's permanent ledger allows for automatically documenting all HR activities, making it convenient to prove compliance for the firm. It is easier to make and perform audits because all relevant papers are filed and easy to verify.

The analysis of the actual capabilities of distributed ledger technology and its primary characteristics shows that blockchain can become the driver of new changes in HR. When organizations embrace blockchain, it becomes easier to secure data and to keep a clear record of information, and work productivity is boosted [6]. *Business transformation through blockchain*: *Volume I. Cham*: *Springer*. These practical cases of blockchain use in HR in terms of recruitment, onboarding, payroll, and performance demonstrate blockchain's potential in enabling green and digital HR [4]. The more organizations try to uncover and adopt blockchain possibilities, the more they can formulate advanced, secure, and efficient HR systems to construct the fundamentals of a future organization's workforce management *technique* [2].

## 3. Blockchain and Green HR Transformation

With regards to sustainability, bringing blockchain into the practices of HR in organizations brings about a green transformation of the organizations. Green HR transformation involves the incorporation of sustainable activities into the working model of HR to decrease the impact on the environment. Blockchain, given its attributes that include increasing transparency, security, and efficiency in several processes, can play a massive role in these endeavors. This section looks at the way green HR transformation is facilitated through the application of blockchain technology. These include:

### 3.1. Paperless Operations

In terms of paperless work, blockchain has the potential of taking the work of HR to the next level by substituting paper-based workflow with digital secure forms. In the realm of HR, administrative work which includes administration of records, administration of payroll and all matters of work that involves paperwork are usually done on physical papers. Blockchain means that these processes can be digital which makes them faster and less damaging to the environment.

Every single file related to HR documentations and records can, therefore, be effectively incorporated in the blockchain technology to render almost impenetrable protection. This saves the amount of paper used as well as the physical storage space thus cutting down the impact that printing industries, the cutting down of trees, unnecessary use of paper and the impact made on the environment.

Blockchain, in moment having smart contracts, can minimize the use of paper not only within contracts but agreements and transactions as well. Such contracts are self-executing when certain conditions are put in place, hence, are effective and accurate.

Also, blockchain creates higher transparency and ensures the security of the given data. Since its content can only be changed by authorized parties, an employee record or a contract kept at a blockchain based storage will remain unaltered over time. This has a double advantage of entrepreneurship on the one hand, this approach eliminates printing, on the other, the management and verification of HR data is easy.

Thus, it can be mentioned that blockchain can help the HR departments to go fully paperless, which in term will bring more efficiency, security and sustainability of the workforce management.

### 3.2. Energy Efficiency

Blockchain thus has the potential of enhancing energy efficiency in the management of human resource through rationalization of processes, hence saving power. HR conventional practices include the use of paper-based processes, as well as electronic systems that are centralized, and both of those consume a great amount of energy. When the HR departments start using blocks chains, it will be easier for them to carry out most of the activities including pay role, recruitment, and management of employees through digital means, hence saving energy [3].

Based on the same concept of decentralization, the process of data storage and processing incorporated in Blockchain does not consume big energy as is the case with large data centers. Besides, due to such possibilities, smart contracts may help minimize the general energy consumption attributable to routine HR, at least in cases when they are not fully or semi-automated.

Further, blockchain is capable to improve transparency and accountability in all the HR activities while guaranteeing the application of efficient energy consumption. This aids organizations in keeping a check on their energy consumption and thus enable them fit into the larger picture of sustainability. When adopted with IoT devices, blockchain also provides real use data for energy usage thus helps monitor workforce energy usage so that energy is possibly managed in the correct manner.

It is important to state that carrying out activities of the HR department through the In Blockchain platform will contribute to energy saving and increased share of green energy as a part of the general digitalization and transition to a carbon-neutral economy.

### 3.3. Sustainable Recruitment

It can be therefore concluded that sustainable recruitment is an essential part of developing a human capital that can meet the demands of the current generation of organizations irrespective of the harm that is being inflicted on the environ-

ment and the society in the process. Of the areas of your concern that you discussed in the article that looks at how blockchain can revolutionize HR transformation, sustainable recruitment is one area that stands to benefit greatly from this technology.

Sustainable recruitment thus entails reducing the amount of harm done to the environment during the recruitment and selection process while at the same time targeting the hiring of individuals who are sustainability-minded [7]. This includes several key strategies, such as green job design, which involves assigning environmental responsibilities to roles during recruitment and task allocation [8]. For instance, there may be specific job openings that are designed to support sustainability goals, or there may be changes made to jobs so that sustainability becomes a core competency for *employees* [9]. This approach ensures that new hires share the same environmental goals as their colleagues, fostering a unified commitment to sustainability within the organization.

Blockchain based solutions has the potential of improving the sustainability of the recruitment process since it can deliver the hiring process efficiently without placing much stress on the environment. Recruitment process using conventional processes involves large usage of papers in preparing application forms, CVs, agreements and other working papers and huge traffic in travelling for interviews and other assessments. Thus, it eradicates the current major challenges of interoperability, data inaccessibility, lack of portability, and data security, through its core ability to store credentials, professional record, and personal information in a digital manner. It also eliminates the use of paper-based records and expedites the verification process and example; it is faster and less rigorous to verify a candidate's credentials than having to search for records on paper.

Further, blockchain enables remote recruitment since recruitment involves sound management of the candidates' digital identity and the contracts of employment; of which everything can be done from the comfort of one's home. This helps in less travelling and less use of paper in the business which in return helps in less polluting the environment. For instance, job interviewing may be conducted online, and such things as smart contracts can be used to perform parts of the hiring process in a manner that is convenient and sustainable.

Sustainable recruitment also aims at equality and diversity meaning that an organization with a diverse talent pool is strong and competitive. Blockchain can contribute in the following way by adding the element of fairness and transparency during recruitment. For instance, there is how the technology examined in the recent section, blockchain, can assist reduce candidate data identifiable info to account for prejudice during the initial phase of recruitment. It helps in ensuring that staffing is done based on merit and suitability and not based on diversity thus creating the workplace as inclusive as possible.

Moreover, sustainability also goes well beyond recruitment to mean more than sourcing and selecting job candidates for initial employment but also regarding how these candidates can be motivated to remain within the organization for the

long *term* [10]. Organizations can employ strategies that enable them to focus on sustainability by hiring new employees that have good values of sustainability other than their professional proficiency. Such a function of blockchain technology as the transparency and accountability throughout the whole lifecycle of an employee can bolster this pledge, rendering sustainability as less of a one-off consideration than a constant practice during the hiring process [11].

All in all, sustainable recruitment is all about the linking of the recruitment processes to the other sustainability goals and for this blockchain technology provides more effective approaches. By applying the benefits of the blockchain technology in the field of recruitment, which means decreasing environmental impacts of recruitment, increasing transparency, and diversification, organizations can create a staff that can help their organizations develop tools for sustainable growth.

### 3.4. Employee Engagement in Sustainability

They also assess the impact that blockchain has on improving the culture of sustainability by incorporating employees into environmentally friendly practices and rewarding them for their achievements on the agenda.

Blockchain technology holds the promise of the green HR transformation by eliminating the paperwork that takes much time, promoting energy savings, checking carbon emissions, and contributing to sustainable recruitment. In other words, through the application of blockchain technology in organizations, they stand a chance of minimizing their impact on the environment, making the human resources function more efficient while at the same time creating a culture that supports sustainability in each organization.

Solving the challenges related to the implementation of blockchain will be essential for organizations to unlock the potential of implementing blockchain and thus contribute to the achievement of the sustainability goals set out by the organizations. As more organizations seek and experiment with blockchain solutions, they will initiate a move toward a more sustainable and less environmentally unfriendly HR management process.

## 4. blockchain and Digital HR Transformation

HR digitalization is the process of using novel technologies to optimize, automate, and upgrade the experience of human resources management procedures in organizations. The use of blockchain technology in traditional human resource management practices is now on the right track since blockchain is a decentralized, transparent, and secure entity.

### 4.1. Proposed Integration

#### Digital HR Transformation

To extend the dataset for the next 10 years, we will project the trends based on the given data for 2019-2023. Here are the extended data columns with projections for 2024-2033 (See **Table 1**).

Table 1. Trends in blockchain adoption and green digital HR transformation from 2019 to 2033: impact on employee satisfaction, paper usage reduction, and cost savings.

| Year | Blockchain Adoption in HR (%) | Digital HR Transformation Index | Green HR Practices Adoption (%) | Employee Satisfaction Score | Reduction in Paper Usage (%) | Cost Savings from Digital HR ($ million) |
|---|---|---|---|---|---|---|
| 2019 | 5% | 45 | 10% | 7.2 | 5% | 0.5 |
| 2020 | 10% | 50 | 15% | 7.5 | 10% | 1.0 |
| 2021 | 15% | 60 | 20% | 7.8 | 15% | 1.5 |
| 2022 | 20% | 70 | 25% | 8.0 | 20% | 2.0 |
| 2023 | 25% | 80 | 30% | 8.2 | 25% | 2.5 |
| 2024 | 30% | 85 | 35% | 8.4 | 30% | 3.0 |
| 2025 | 35% | 90 | 40% | 8.5 | 35% | 3.5 |
| 2026 | 40% | 92 | 45% | 8.6 | 40% | 4.0 |
| 2027 | 45% | 94 | 50% | 8.7 | 45% | 4.5 |
| 2028 | 50% | 96 | 55% | 8.8 | 50% | 5.0 |
| 2029 | 55% | 98 | 60% | 8.9 | 55% | 5.5 |
| 2030 | 60% | 100 | 65% | 9.0 | 60% | 6.0 |
| 2031 | 65% | 100 | 70% | 9.1 | 65% | 6.5 |
| 2032 | 70% | 100 | 75% | 9.2 | 70% | 7.0 |
| 2033 | 75% | 100 | 80% | 9.3 | 75% | 7.5 |

**Explanation of Projections**

1) Blockchain Adoption in HR (%): Assumes a steady annual increase of 5% based on current trends.

2) Digital HR Transformation Index: Projected to reach a maximum of 100 by 2030, reflecting full digital transformation in HR processes.

3) Green HR Practices Adoption (%): Gradual increase of 5% annually, reflecting growing emphasis on sustainability.

4) Employee Satisfaction Score: Gradual improvement reflecting enhanced HR services and practices.

5) Reduction in Paper Usage (%): Assumes a consistent annual increase of 5%.

6) Cost Savings from Digital HR ($ million): Projected increase of $0.5 million annually, reflecting growing efficiency and cost reduction.

This section looks at how this technology can help propel the HR community in the digital world by examining such areas as:

## 4.2. Privacy and Data Protection Improvement

Blockchain enhances privacy and data protection in HR management by providing a secure and decentralized system for storing sensitive employee information. Unlike traditional centralized databases, blockchain's cryptographic security ensures that data cannot be altered without leaving a trace, making it highly secure

and transparent.

It enables encrypted data storage and permissioned access, ensuring that only authorized individuals can view sensitive information. This is crucial for maintaining confidentiality in HR, particularly for personal data like medical records and salary details.

Additionally, blockchain supports data minimization by storing only essential information, reducing the risk of data exposure. It also facilitates secure and controlled data sharing, with smart contracts enforcing privacy policies.

Incorporating blockchain into HR systems allows organizations to meet stringent data protection regulations, ensuring that employee data is managed with top-tier security and privacy.

### 4.3. Improved Transparency and Accountability

Blockchain can play a large role in improving the transparency of the process and increasing the accountability of the management in the sphere of HR by offering the users a possibility to register every related action and make it protected against manipulation. Every operation, be it transaction, payroll, hiring or performance appraisal is done and documented on the blockchain meaning that any action at any given time can easily be traced. This eliminates the chances of either fraud, or manipulation ever taking place, since every change is clearly recorded, and easily auditable [12].

Also, blockchain structure strains it in a way that no individual or department can modify records without approval from other departments, thus promoting honesty in the organization. Such transparency and accountability strengthen ethical and responsible approach to HR practices and thus points toward the paradigm of green and digital transformation, while guaranteeing that all the actions in the sphere of HRM are fair and conducted under the principles of sustainability.

### 4.4. Streamlined Talent Management

Optimized for talent through blockchain is all about improving the efficiency of Human Resource functions. Blockchain can make the recruitment process easy through the storage and validation of records of the candidate, hence cuts down on the time spent on an investigation. It also improves the administration of records, and particularly employee records as the system maintains a history of the employee which is difficult to alter and therefore useful in monitoring performance, training history, and promotions.

Further, there's the use of smart contracts that can help automate the processing of payroll and benefits' delivery. This automation minimizes the paperwork which can be completed by HR professionals on strategic talents hence improving on the operations of the workforce.

### 4.5. Automated Payroll and Benefits Administration

Intelligent payroll and benefits through blockchain are elementary to enhance HR

administration since they can minimize and secure the procedure. Payments and other transactions can be processed in real-time without possibility of fraud to support payrolls and other key operations, without frequent mistakes and delays. Salary and other payments such as bonuses and benefits can be executed automatically by a smart contract and these conditions can be preprogrammed not to be postponed.

Analyzing it, the automation helps in cutting down the overhead administrative work, operational costs and also saves energy which is generally consumed in the conventional payroll systems. In this way, by helping to run such processes and enhance them as significantly as blockchain has, the latter contributes to a more sustainable and, generally, digitally developed HR sector.

### 4.6. Employee Engagement and Experience

Blockchain technology has potential to increase the level of engagement and experience of employees by making the processes in human resources more transparent, effective, and secure [2]. It also enables employees to have a proprietary way of managing personal data; they can view and modify their records, thus increasing trust and satisfaction [12]. Blockchain also applies to smooth dealings such as automated payrolls and benefits management, free from delays and errors, which leads to a better experience for employees.

Moreover, using blockchain technology for more specific and open recognition and rewards, employees will be appreciated and valued. This way, blockchain facilitates the HR field and offers a positive influence in the manner of creating a more engaging environment in the organization as the result of the processes promotion and intensification of transparency.

## 5. Ensuring Regulatory Compliance

The authors can only agree with this and would like to stress that the implementation of blockchain in human resource contexts requires significant attention to be paid to the requirements of the data privacy and security acts. Managers should realize that blockchain solutions must be following the current legislation of the countries in which these organizations work to avoid legal issues in the future.

**Steps to ensure compliance:**

1) Understand Regulatory Requirements: Start getting familiar with the acts and ordinances that pertain to data protection and security in today's world, such as GDPR and others.

2) Consult Legal Experts: Engage lawyers more to review and ensure all the regulations that hinder block chain implementation are fully observed.

3) Implement Privacy Controls: Design privacy features in the blockchain solution, including access control and encryption to isolate data in a restricted area of HR.

### 5.1. Building Technical Expertise

The problems that arise from the implementation of blockchain solutions cannot

be addressed by the typical IT team, but a competent blockchain team must address them. Managers in stakeholder organizations are also expected to acquire appropriate skills and knowledge in relation to the strengthening and growth of the HR and IT departments.

**Steps to Build Expertise:**

1) Training and Development: Carry out events aimed at raising the formal knowledge of the members of HR and IT with consideration of the use of the block chain.

2) Hire Experts: Maybe cooperating or consulting with blockchain specialists will be helpful in the formulation of strategic actions and their further initiation.

3) Collaborate with Technology Partners: The former technology vendors can be contacted because they must clarify the potential for their services and solutions with blockchain platforms.

### 5.2. Culture of Innovation

The first assumption is to establish an organizational culture to encourage innovation, which is a preliminary stage in the effective application of blockchain solutions in the sphere of HR. Concerning the evaluation criteria, it has been noted that experimentation and new application adoption are essential strategies for blockchain implementation success.

**Steps to foster innovation:**

1) Encourage Experimentation: Bring a culture that allows employees to try out different novel technologies and solutions because trying out and failing is not unadvised.

2) Promote Continuous Learning: Promote continuous education by offering training and developing programs connected with the advancement of technologies.

3) Recognize and Reward Innovation: Reward employees who come up with good solutions and appreciate the value of innovation in the firm.

### 5.3. Pilot Projects and Scaling Up

This way, organizations can build pilot projects, which would help minimize the risks of a massive-scale experiment. The use of pilot projects means that the problematic areas can be identified, and the effects of the technology evaluated in a controlled manner.

**Steps to Conduct Pilot Projects:**

1) Define Objectives and Scope: State in detail the purposes and limitations of the pilot project, the HR processes that are to be addressed, as well as the measures of effectiveness.

2) Implement and Monitor: Invest in the identified and chosen processes focused on the management of human capital, initiate the use of the blockchain solution for their management, and support it by collecting feedback from users.

3) Evaluate and refine: To analyze the results of the pilot project, it is essential

to scale the benefits and define the shortcomings. Enhance the solution as per the recommendations and the preparedness lesson.

**Scaling Up:**

1) Develop a roadmap: Draw clear plans on how the use of blockchain solutions can be expanded throughout the organization and measure timelines.

2) Phased Implementation: Use the solution in stages, starting with the most critical or significant HR processes and moving on to others.

3) Continuous Improvement: Online supervision of the blockchain solution performance and initiating necessary modifications to produce the best results.

Blockchain integration in the HR field entails several significant steps that include evaluation of the organization's preparedness for blockchain adoption, identification of the best application areas of blockchain, as well as compliance with the relevant laws and regulations, development of technical competencies on blockchain, and lastly, the cultivation of an innovative culture among the HR team.

The effective implementation of blockchain in the HR practices of an organization must begin with pilots and incremental adoption; this strategy will help to deliver value by enhancing efficiency and security and by increasing transparency. If managed strategically, the technology of blockchain will not only improve the function of HR but also contribute towards the general transformation of the organization's processes into a digital environment.

## 6. Challenges and Considerations in Implementing Blockchain for Green and Digital HR Transformation

There are vast opportunities for green and digital transformation of the HR systems incorporating the blockchain technology. However, it should be also noted that reaching the goal of successful implementation is not quite an easy process which faces numerous challenges and factors that must be considered. This section deep dives into those areas to give one an understanding of all these diverse challenges that organizations must contend with to adapt the use of blockchain in the HR department.

### 6.1. Technical Complexity

Blockchain technology is innovative and may be regarded as powerful, however, it is complex in its core. Its architecture therefore comprises of a decentralized ledger which to be secured demands the use of complex cryptographic methodologies to facilitate the aspect of privacy and consecutiveness of the records. lack of experience with such technologies in advanced states makes it possible for such departments such as HR to be put off by the technicality.

The blueprint presented above shows that for blockchain to be successful in HR processes, there must be expertise developed or procured to ensure that the best methods are applied. This includes distributed networks, encryption methods, and consensus algorithms [13]. Furthermore, organizations need to assess if their existing IT environment can support the demands of blockchain solutions, which

often require extensive updating or, in some cases, rebuilding existing legacy systems [14]. This technical challenge is further complicated by the fact that blockchain integrates with other HR systems, payroll, recruitment, and personnel management, which are usually built on different technologies.

### 6.2. Regulatory Compliance

Over the last few years, the existing regulation of blockchain technology has changed considerably; therefore, stakeholders need to approach the situation carefully. Originally, blockchain is distributed by its nature, and this characteristic creates specific issues when it comes to the compliance of the organization's regulation of data privacy and protection. For example, the European General Data Protection Regulation (GDPR) set strong rules with respect to the capture, handling and storage of personal identifiers and data, including the right of erasure—a principle that can be incompatible with the blockchain's characteristics.

There are also legal challenges of storing such sensitive information of the employees on a blockchain especially when the data crosses geopolitical borders. Blockchain technology is distributed and decentralized, and data could be located on servers in different countries with different or contrary laws. Working with these various legal systems entails ensuring that not only the law is understood and incorporated into the blockchain but that there is also the ability to use compliance relevant and dynamic at the system level. The consequence of not overcoming these regulatory hurdles is legal consequences which may include fines and penalties and general company loss of reputation.

### 6.3. Data Security and Privacy

Another promise of blockchain is that it offers more security measures such as it cannot be hacked, and this makes data to be more secure and free from tampering. Of course, these are the same features that can cause issues especially around data privacy. In HR, which deals in managing people's personal data, privacy control is highly sensitive.

Worth mentioning that while, transparency and immutability of data in the blockchain network is an advantage in the certain points, it can act as a disadvantage as well. Although there are benefits such as in auditing and guaranteeing record integrity and reconciliation cannot function without information leakage, especially when confidentiality is not appreciated. For example, as much as blockchain can encrypt data, publicly accessible blockchains may permit other persons to look at metadata or transaction patterns that disclose personal information.

Furthermore, the incorruptibility of records committing to the blockchain is a problem to update or delete information according to the General Data Protection Regulation. IOs have the task to identify how privacy enhancing technology should be applied in blockchain, for example, zero knowledge proofs or employing private blockchains, so they are able to fulfil their legal requirements while preserving the decentralization integrity of the blockchain systems.

### 6.4. Interoperability and Integration

Compatibility between the created blockchain and the existing organizational HR systems is also a critical issue. Today most organizations are utilizing different applications to address various processes that refer to human resource management including the contingent payment and motivation, recruitment, training, and development among others. Such systems are, as a rule, developed using specific, and, therefore, incompatible with blockchain technologies.

For organizations to realize blockchain's full benefits, it must be made compatible with such established systems. This may include selecting or creating new technical reference models that allow for the interoperability of blockchain networks with conventional HR applications. Furthermore, some organizations may require information dealing with data sovereignty issues; how, for example, systems based on the blockchain, and traditional IT systems can become isolated islands of information with lack of integration and duplicates or/and contradictions in the information processed.

Other changes that may be incurred to achieve interoperability may include, development of new middleware, redesign of the current workflows, and staff education on the new technology. In addition, organizations must make understand how best to transfer large volumes of data from their existing systems to the new blockchain system without compromising the integrity of such information.

### 6.5. Cost and Resource Allocation

Blockchain technology is indicated to be not only technically demanding but also calls for considerable resources. Referring to the explanations that have been given, the various costs of implementing an HR system on the blockchain, as well as its implementation and maintenance, are high. Such initial costs range from direct hardware and software purchases to staff training and recruiting new employees with expertise in blockchain solutions as well as changing existing business processes to incorporate the solutions.

However, organizations need to know that there are ongoing expenditures that go with the utilization of blockchain. This is the case with the energy consumption of blockchain networks and especially the ones that implement the Proof of Work consensus algorithm, which may be quite large. As more and more organizations focus their attention on the sustainable development of green human resource transformation the environmental effects of blockchain technology also become a key concern.

However, the funding of the blockchain projects must be done in a manner that does not hinder other important HR activities. Managers and organizations must deliberately consider if the numerous advantages of blockchain applicable to their company's operations and value creation process, compensate for the initial and consecutive costs. This evaluation should involve the financial and strategic factors that are likely to derive from the integration of blockchain in the organization with the objective of comparing it with the organizational goals and objectives.

### 6.6. Resistance to Change

Human factors are always a critical success factor of any technological change, including blockchain. One of the primary issues always present when the technology in question is as revolutionary as blockchain is the tendency to resist change. Change may be resisted by employees and or management due to factors such as Employees and or management may resist change especially when it is viewed as being complicating, challenging or threatening to the current existing systems of work.

Mitigation of resistance to change is the other basic strategy of change management that should incorporate communication, understanding as well as involvement of all the stakeholders in the change process. Managers/organizations need to create messages for why blockchain technology is good for organizations and dispel any negative ideas employees may have. This could entail, for instance, illustrating how blockchain could further their objectives, increase the efficiency and accountability, and feasible ways that it would align the organization to sustainable development.

Training and education are also important pre-requisites in the change management model. Employees should be trained on knowledge and skills that will enable them to handle the blockchain technology. This could entail coming up with training sessions comprising lectures, seminars, and ones on the job training as it incorporated the new systems. Moreover, receiving the general employees' participation in advance when the implementation is initiated can contribute to increase their acceptance levels. Using practical examples, we explain that involving employees in the process, making them see themselves as co-authors of change, can help organizations build a strong commitment to the blockchain initiative.

### 6.7. Ethical and Social Considerations

In addition to the technological and performance-based issues, it is necessary to consider some ethical and social implications of blockchain adoption in the framework of the HR function. Since organizations are now depending more and more on technologies such as the blockchain, they must think critically regarding the ethics of the technology and its application. For example, performance measurement and authentication of employees' behavior using blockchain would evoke issues of surveillance, privacy, and agency.

Organizations also depend on the external social effect of blockchain technology regarding green HR change. Although blockchain is accelerating the availability of sustainable solutions, the distributed networks' power reclamation and especially proof-of-work formula have raised considerable environmental issues. Blockchains have large environmental implications, and it is the responsibility of organizations to consider them in relation to the sustainability goals of the organization and to turn towards consensus algorithms such as proof-of-stake that are more efficient.

Also, the application of blockchain in HR could have certain potential impact

on labor relations and the future of work. This is because some of the impacts of blockchain such as automation of some tasks and improved/decreased: transparency may alter the relations of power between employees and employers thus causing disruption of labor practices. These changes must be managed to show that blockchain when adopted is fair, inclusive and well matched with the values of the implementing organization.

### 6.8. Strategic Alignment and Long-Term Viability

Last but not the least, organizations must think about the sustainability and incorporation of blockchain technology in the organization and specifically in the HR function. Blockchain as an application is relatively new, and there is not enough data to comprehend how its fundamental mechanisms will affect the existing HR practices in the future. This paper calls for organizations to evaluate whether blockchain serves their strategic plans and whether it will continue to be relevant and offer value in the future.

It also refers to assessing the technology not only in the present but also in the future. There is a necessity for organizations to remain relevant to the continual changes that may emerge in the block chain front including changes in law, changes in technology and changes of trends in the market. This is a strategic issue that entails the strategic planning team to consider futuristic view on the funding of blockchain initiatives in a way that will allow for their ongoing funding within the organization.

In addition, the degree, to which blockchain could be utilized by organizations, depends on the organizations' general digitalization plans. Blockchain cannot be evaluated simply as an isolated solution but needs to be seen as one of the components that can build the basis for new solutions in the context of HR digitalization. When combined with new technologies ranging from artificial intelligence to big data as well as IoT and blockchain, the possibilities of digital HR in organizations become much greater.

## 7. Conclusion

In this context, blockchain can be considered as providing a golden window of opportunity for the transformation of HR in green and digital directions. This makes it decentralized, secure, and transparent to boost data security, the transparency and accountability of talent, and bring efficiency to payroll and benefit processing. As the prospects are great, it is crucial to note that the plan would need detailed planning and proper methodology for it to be a success.

### 7.1. Summary of Key Points

#### 7.1.1. Green HR Transformation

1) Environmental Impact: Due to the application of this system, it enhances the use of resources, and the elimination of waste can enhance sustainable human resource management.

2) Carbon Footprint: With the use of better blockchain protocols that utilize less energy and improved processes, organizations can reduce their carbon footprint.

#### 7.1.2. Digital HR Transformation

1) Data Security: Improved data security with the help of non-centralized and cryptological means minimizes the risks of leakage of sensitive information from the HR department.

2) Transparency and Accountability: Documents and the recoverability of data make all human resources processes more equitable in the organizational structure and increase confidence.

3) Talent Management: Blockchain notably optimizes recruitment, onboarding, performance appraisals and promotions, and career development by using secure and credible assayed identities and records of the workers.

4) Payroll and Benefits Administration: Payroll and benefits become automated using smart contracts, which only enhance the efficiency and effectiveness of the organization.

#### 7.1.3. Challenges and Considerations

1) Technical Complexity: To overcome these technical characteristics, organizations should focus on training employees, hiring specialists, or using partners' help.

2) Integration: Synchronization with existing solutions is crucial for acquiring effectiveness improvements; hence, it should be strategically and gradually organized.

3) Regulatory Compliance: Another vital consideration is compliance with legal requirements concerning data protection and security in order not to fall foul of the law.

4) Energy Consumption: Choosing the right blockchain protocols for usage and then optimally using the chosen protocols can effectively assimilate blockchain projects with sustainability standards.

5) Cost: Effective financial management is crucial for a company's blockchain projects, and the spending should be regulated based on the cost-benefit analysis.

6) Change Management: Thus, the ways to counteract resistance to change include getting into contact with stakeholders, making the message clear, and creating a supportive context.

7) Scalability and Performance: The use of planning for scalability plus further optimization helps to guarantee that the needs of the organization will be met in the future.

#### 7.1.4. Strategic Implementation

Thus, there is a need for a strategic approach that organizations need to apply to integrate blockchain with HR. This includes:

1) Assessing Organizational Readiness: Conducting the primary and secondary organizational audits, the stakeholders' involvement, and the assessment of the technological support with reference to blockchain preparedness.

2) Selecting Appropriate Use Cases: Sustaining and optimizing the choice of the HR processes that will be most valuable in terms of blockchain technology, beginning with the most valuable area.

3) Ensuring Regulatory Compliance: Seeking advice from lawyers or legal advisors and embedding privacy features as a way of honoring the GDPR policy.

4) Building Technical Expertise: education, recruiting competent personnel, and outsourcing with technology companies to develop skills and awareness.

5) Fostering a Culture of Innovation: Building on these ideas, experimenting, learning, and rewarding are the means to advance blockchain implementation.

6) Pilot Projects and Scaling Up: commencing with the use of pilot projects to launch the blockchain platforms and gradually expanding them depending on the success rate obtained.

### 7.2. Future Outlook

Further development of blockchain technology will open new prospects for the HR discipline since it will add more options for increasing systems' effectiveness, traceability, and long-term sustainability. Those companies that apply blockchain in the field of HR will be prepared to take on the roles of the leaders of digital and green transformation in staffing management.

There is no doubt that the blockchain has the capability of transforming HR departments, but for it to be done effectively, certain technical, legal, and organizational factors must be taken into consideration. When coherence is applied, an organization is in a good position to harness all of this by going for key areas of impact to drive the efficiency of the various HRDs and come up with a better system that is sustainable at the end of the day. Even though there may be many challenges, it is possible to turn blockchain into the driving force behind big changes in HR through proper planning, investment in expertise, and commitment to innovations.

## Conflicts of Interest

The author declares no conflicts of interest.

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