Blockchain Applications in Human Resources Management: Opportunities and Challenges

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ABSTRACT

Blockchain is perceived as a revolutionary technology offering considerable impact on a vast magnitude of sectors including healthcare, supply chain, Internet of Things (IoT), finance, voting systems, property and real-estate management, e-government, higher education, etc. This paper examines the results of an empirical study that conducted ten in-depth, one-to-one semi-structured interviews with Human Resources Management (HRM) experts in order to identify the potential opportunities related to blockchain technology utilization in the HRM domain as well as the anticipated adoption challenges that may hinder its utilization. The study is of significance to both blockchain and HRM researchers who can utilize the proposed opportunities as a future research agenda and work towards mitigating the anticipated adoption challenges.

CCS CONCEPTS

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Blockchain, human resources, bitcoin

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1 Introduction

Blockchain is the supporting technology for bitcoin, a Peer-to-Peer (P2P) electronic cash system [1]. The blockchain is a distributed public P2P ledger with no central authority managing it [2], containing only authentic information [3]. The blockchain maintains a continuously growing list of linked and stamped blocks that store transactions. Storage audits are used to enforce data sharing policies and hinder unauthorized operations without centralized systems reliance [3]. To ensure blockchain integrity, all information is encrypted [4]. Blockchain eliminates the need for third party validation via utilizing a consensus mechanism in which network validators agree on the ledger state. Moreover, the transaction becomes permanent as soon as it is recorded and verified [5].

The effective human resources utilization is fundamental for creating competitive advantage and achieving organizational objectives [6] as well as developing and maintaining a strong positive corporate reputation [7]. Human Resources Management is focused on applying a strategic approach embedded in a societal and organizational context to manage employees to enhance their commitment and capabilities [8].

HRM has three subdomains [8]:
(1) **Micro HRM (MHRM):** focused on managing employees and small work groups;
(2) **Strategic HRM (SHRM):** concerned with linking business strategies with HR strategies and assessing its effect on the performance of the organization; and
(3**) International HRM (IHRM):** focused on managing employees in multinational organizations.

HRM functions can be explained as follows [7]:
(1) **Staffing:** staffing activities include HR planning, recruitment and selection, training and development, compensation and rewards, as well as employees' retention.
(2) **Performance:** performance activities focus on training and development, reward systems, performance management, union-

management relations, and labor relations in order to maximize performance.
(3) **Change Management:** change management activities include recruitment, training, reward systems, enhancing employees' involvement, and conflict management.
(4) **Administrative:** administrative activities focus on ensuring legal compliance and record maintenance.

Less than 20% of blockchain research is focused on blockchain applications [12]. Recent systematic literature reviews focused on domain specific blockchain applications revealed the need for researchers to pursue research on blockchain application areas suffering from scarcity of research; those areas include sociotechnical aspects related to the blockchain technology [13] and non-financial applications [12]. The few presently available research papers on HRM blockchain applications also suffer from insufficiency of both empirical and theoretical studies as well as being focused on limited aspects, for example, verifying job applicants' credentials [15] and data storage and management [16]. Consequently, this motivated our research team to perform an exploratory empirical research that conducted ten in-depth, one-to-one semi-structured interviews with HRM experts in order to identify the potential opportunities related to blockchain technology utilization in the HRM domain as well as the anticipated adoption challenges that may hinder its utilization.

The study results on HRM blockchain opportunities set a future research agenda for both blockchain and HRM researchers. Furthermore, researchers can also work towards resolving the study's anticipated adoption challenges.

This paper is organized as follows: section 2 explores the relevant literature; section 3 presents the research method; section 4 provides the interview results; section 5 provides the results discussion; and finally, section 6 presents the conclusion.

2 Background

Blockchain technology has the potential to drastically transform the way in which we live and transact with each other since it offers several benefits including fraud prevention, decentralization, security and ownership of data. Due to its anticipated benefits, several research avenues have emerged that study different perspectives of blockchain technology including computer science, information systems, law, finance, and politics, etc. [9]. Numerous research papers have discussed applications of blockchain in different domains including voting systems, supply chain [10,16], property and real-estate management, healthcare [10,16], IoT [10,16], higher education [10], e-government and smart government, personal reputation management, freedom of speech, and anti-corruption [11].

A recent systematic mapping study on blockchain technology exposed that over 80% of blockchain research papers focus on the bitcoin system and less than 20% discuss other blockchain applications [12]. Furthermore, a systematic literature review study shed light on the fact that the main stream publications primarily concentrate on technological and business topics and are often confined to the disciplines of computer science and information systems rather than emphasize the broader societal, political or judicative questions [9]. Another study revealed that there are many further research directions to pursue related to sociotechnical research and the implications and development of the blockchain for individuals, organizations, and society [13].
Furthermore, there also exists a significant insufficiency of academic papers focused on blockchain utilization in the HRM domain; the few published papers discuss only few aspects including blockchain impact on new jobs, blockchain benefits for the HRM process, and a single proposed HR information management model for utilizing the blockchain.

Lukić, et al. investigated blockchain effects on HRM and concluded that it will lead to the creation of new technological and non-technological job positions which will be introduced as a consequence of the blockchain technology, for example, blockchain developer, blockchain designer, project manager, blockchain quality engineer, blockchain concept developer, legal consultant, blockchain analyst, blockchain architect, blockchain research scientist, technical researcher, blockchain backend engineer, staff blockchain engineer, and blockchain algorithm engineer [17]. The paper, however, does not provide enough further details on what each of those job entails.

Moreover, Blockchain positive effects on the recruitment process were also explored by Lukić, et al. and they concluded that blockchain will lead to saving time and money consumed in the selection process as well as improve its quality and ease of verifying of employees' information, standardization of career profiles, and easier recording and tracing of career improvements [17].

Wang, et al. [15], proposed a blockchain based HR model that used the blockchain for recording HRM information, certification of HRM documentation and payment of employees' salaries. Examples of the information recorded include employees contact details, prior jobs, promotions, competencies, training, salary and performance appraisal. Once the HRM information is verified, it is stored in the accounting book in the form of a digital contract. The paper, however, fail to offer sufficient specifics on whether the model was evaluated via real life case studies.

This study aimed to address the identified research gap via focusing on the under-represented research area of blockchain sociotechnical perspectives as well as blockchain HRM applications. This aim was achieved via conducting an empirical study to explore the landscape of potential opportunities that blockchain can offer to the HRM domain as well as the anticipated adoption challenges.

3 Research Method

This section delves into the research method specifics regarding research questions, data collection, data analysis and participants and organizations profiles.

3.1 Research Questions

The goal of this research is two-fold: first, to identify the opportunities that blockchain technology can offer to the HRM domain, second, to identify the anticipated adoption challenges hindering those potential opportunities. Accordingly the following research questions were posed to ten carefully selected HRM experts via one-to-one semi-structured interviews.

Research Question 1:

What are the potential opportunities that can be offered to the HRM domain via the blockchain technology?

Research Question 2:

What are the anticipated challenges that can hinder the utilization of the blockchain technology in the HRM domain?

3.2 Data Collection

The data collection method of choice was semi-structured interviews due to its adaptability, flexibility and the possibility of following-up interviewees responses and providing informative material [14].

Several criteria were carefully considered and set in order to choose the HRM experts. Those criteria were as follows:

1. their area of expertise must be in the HRM domain to ensure their domain knowledge.
2. their years of experience must be at least 10 years of work in HRM related facets to guarantee in- depth knowledge.
3. their organizational role must be varied to cover different aspects of HRM functions, for example, training, recruitment, etc. in order to achieve thorough coverage of most HRM related dimensions.
4. their organizations must cover a broad range of industries in order to provide wide coverage of potential opportunities and challenges of HRM blockchain applications in different businesses.

With the guidance of the previous criteria contacts with HRM experts were established via networking and referrals. The study conducted ten in-depth, one-to-one, face-to-face interviews with ten participants working in different industries. The organizational role of the interviewees varied between HRM managers, HRM consultants, and training managers who are working in a variety of organizations as illustrated in table 2 and 3. Those organizations cover numerous domains, for example, education, charity, healthcare, industry and finance. Moreover, the organizations were chosen to cover different types including profit and non-profit oriented as well as national and international organizations.

An informed consent form was prepared that explained the purpose, duration, data collection, security and anonymity process and asked for participants' permission to record the interviews. All interviews except two were recorded. For the two interviews in which participants refused the recording, hand-written notes were used. All interviews were conducted in Arabic and later were transcribed and translated into English.

3.3 Data Analysis

Thematic analysis is our chosen method for recognizing, scrutinizing, classifying, and reporting data patterns [14]. A theme focuses on identifying and representing meaningful data patterns.

Thematic Analysis Phases

Boyatzis [14] thematic analysis phases were adopted as follows:

1. Data Acquaintance: focuses on achieving full understanding and awareness of the breadth and depth of data. This involved transcribing interviews and data familiarization.

2. Generating Initial Codes: involves identifying codes as the simplest, most significant data related to a particular phenomenon [14]. In this phase, we systematically and thoroughly coded significant, relevant data throughout the full data set and then collated data relevant to each code. This phase generated initial codes that pinpoint noteworthy data relevant to the scrutinized phenomena. Those initial data codes were revised for redundancy and merger occurred for similar codes. The final number of codes were 23. Examples of those codes were blockchain utilization challenges, layoffs, performance appraisal, and educational credentials fraud.

3. Themes Exploration: involves assembling final codes into candidate themes, collecting all data related to each potential theme, and organizing relevant data extracts related to the identified themes.

4. Themes Review: focuses on refining potential themes to achieve meaningful coherence and themes distinction via examining theme relevance to the coded extracts and the full data set. This phase caused the exclusion of a number of themes due to redundancy, or absence of sufficient supporting data.

5. Themes Naming: involves refining each theme name in light of the overall data analysis results. It ended in clearer and more expressive themes naming.

3.4 Participants' and Organizations' Profiles

The following sections provide details on participants' and organizations' profiles.

Participants' Profiles

Participants will be denoted as PT1..PT10. Table 1 provides an overview on participants' profiles.

Table 1: Participants' Current Jobs and Work Experience

No.	Job	Years of Experience
PT1	HR Operations Manager	15 years
PT2	HR and Admin Director	17 years
PT3	General Manager of Training	35 years
PT4	Senior Customer Training Coordinator	12 years
PT5	HR Manager	30 years
PT6	Member in Staff Development and Learning Committee and Separation Committee and Salary Survey Trainer	24 years
PT7	Head of HR and Admin	13 years
PT8	HR Consultant	37 years
PT9	Training Manager	14 years
PT10	HR Manager	25 years

Organizations Profiles

Organizations will be denoted to as O1..O12. Table 2 provides an overview on organizations' profiles whereas table 3 provides an overview of organizations' types.

Table 2: Organizations' Domain, Type and Number of Staff

No.	Domain	No. of Staff
O1	Industrial Solutions	150,000
O2	Charity Fund Raising	830
O3	Financial	300
O4	Oil and Gas Engineering Projects	3000 in Egypt
O5	5 Star Hotels Chain	1300 in Egypt
O6	Health	7000
O7	Hair Products	600 in Egypt
O8	Cancer Cure and Prevention Hosp	5000
O9	Bank	600 in Egypt
O10	Education	140 in Egypt

Table 3: Organizations' Type

No.	Type	Profit Status
O1	International	Profit Oriented
O2	National	Non-Profit Oriented
O3	National	Profit Oriented
O4	International	Profit Oriented
O5	International	Profit Oriented
O6	International	Non-Profit Oriented
O7	International	Profit Oriented
O8	National	Non-Profit Oriented
O9	International	Profit Oriented
O10	International	Profit Oriented

4 Results

This section discusses the emerging themes and links them with the interview data to illustrate the results.

4.1 Theme 1: Potential Blockchain HRM Application Areas

The first theme is related to the potential application areas of the blockchain technology that are not yet implemented in the HRM domain. Blockchain can be utilized in several HRM activities as illustrated below.

4.1.1 Performance Appraisal

Performance management is one of the HRM functions that is focused on performance maximization via different activities including performance appraisal, training and development and reward systems. Different employers are interested in previous performance appraisals of candidate employees since it can be an indicator of their behavioral and technical skills and accordingly an important factor in deciding whether they are the right candidates for the proposed job.

Several participants discussed their desire to utilize blockchain in checking performance appraisals of candidate employees to verify their performance potential and suitability for the advertised job. Participant PT3 stated that "performance appraisal can be useful for current and candidate employees…utilizing blockchain in performance appraisal can eliminate bias and subjectivity." Participant PT5 mentioned that "it would be beneficial to know the employee's performance appraisal and misconduct in his previous jobs from the blockchain…it will be useful in achieving transparency, planning and accessing trusted data that can help with allocating employees for internal vacancies." Participant PT6 stated that "performance appraisal on the blockchain will decrease the recruitment cost via eliminating the recruitment of incompetent employees. Blockchain will help in recruiting the right employee to the right position…the cost of recruiting unqualified candidate and hiring him is expensive because of his huge entitlements."

Participant PT7 mentioned that "we have a problem since in spite of the well-written CVs presented by the candidates during the recruitment phase, when they join work, they show poor performance…so if we can verify performance appraisals from the blockchain, it will make a big difference." Participant PT8 stated that "accessing historical employees' performance appraisals in prior jobs via the blockchain will be great."

4.1.2 Verification of References

Contacting references is a crucial part of the recruitment and selection HRM function since it helps verify the employee's technical and behavioral skills as well as work experience. HRM staff are occasionally faced with occurrences of fraud of reference letters that may result in recruiting incompetent employees.

Participants discussed their interest in using blockchain in references checking. Participant PT5 stated that "it would be beneficial to use the blockchain in reference checks; we were

subjected to forger of references when an ex-employee forged a reference letter from our organization and his new employer in USA called us to verify the authenticity of the letter and I was in the position to clarify for the new employer that this employee has included in his reference letter an incorrect job position."

Participant PT9 mentioned that "blockchain can be useful in reference check since it will help us know the history of the job candidate. Currently, when verifying background references, I check with the former employer not the current one to avoid letting him know that the employee is planning to leave. So, the blockchain would be useful if it provides up-to-date information regarding employees' performance and conduct."

4.1.3 Verification of Training Centers and Trainers' Credentials

Staff training is a key activity involved in 3 main HRM functions: staffing, performance and change management. Staff training is focused on delivering the most suitable training to employees to excel in their jobs and in the long term it leads to increased job satisfaction and employee retention.

Another potential application for blockchain technology in the HRM domain that is not implemented so far but would be valuable to the HRM domain is to include the evaluations of both the training centers and the trainers on the blockchain, accordingly potential clients can check the cumulative evaluation of both training centers and trainers.

Participant PT2 stated that "it will be beneficial if training center evaluations were available on the blockchain because we have a huge problem with training providers since there are few providers and their service rendering cost is very high." Participant PT3 also stated that "finding a well-qualified specialized training center to provide training to our staff is very challenging. We cannot study the whole market of training providers in order to identify qualified and currently qualified operating ones. I need to be updated with financial training sector changes in addition to educational institutes. Recently, educational institutions have training centers that I can cooperate with; however, I need to be updated with their performance through the reviews conducted to evaluate their services. How could I know that a particular training center is good or not? I cannot depend on a particular person's subjective opinion…. CVs of instructors are not enough to judge their performance so it would be beneficial to include their evaluation on the blockchain."

Participant PT8 stated that "It will be good for development and education to include training center evaluations on the blockchain." Participant PT4 mentioned that "there is a lot of wasted time in paper work involved in checking trainers' credentials. It takes considerable time and effort." Participant PT5 proposed blockchain utilization in recording the evaluation of training center instructors as well as the trainees' attendance and evaluation. Participant PT5 stated that "employee attendance, exercises and final test in the training courses can be saved on the blockchain. This can help me with future allocation of employees to further training. I can take the decision according to their performance in previous courses."

4.1.4 Salary Surveys and Payment of employees' salaries

Salary surveys is a tool used by HRM managers to define a competitive and fair salary. Different corporates buy salary surveys from salary survey providers. Several interviewees expressed their desire to utilize the blockchain to store their salary scales anonymously as well as access other organizations' salary scales rather than paying huge amounts of money to salary survey providers. Moreover, international mobility can be enhanced via utilizing cryptocurrency in payment of employees' salaries.

Participant PT1 stated that "salary survey is an important utilization area for blockchain." Participant PT6 explained that "for salary surveys, it is very important for us to have updated information from different companies on salaries and our regulations do not allow to seek the assistance of external consultants to do such salary surveys." Participant PT7 mentioned that "a new area that blockchain can help in is salary surveys and benchmarks. It would be helpful if our company can upload the salary ranges without mentioning its name and other companies would do the same in order to have data transparency, thus we will not need salary survey consultation that that may cost up to 50,000 L.E. "

Participant PT9 stated that "it would be useful if the blockchain allowed us to know employees' pay ranges because we will not need to do the survey to know the best pay for each employee." Participant PT8 stated that "it would be advantageous if blockchain adds value to salary and benefits surveys via offering trustworthy data in much less time." Participant PT2 stated that "it would be useful if blockchain is used in grading and salary schemes because it is confidential data and it should not be publically accessible because it is an area that organizations compete in and we pay money to get this information from salary survey corporates." Participant PT7 added that "payments of salaries via the blockchain (cryptocurrency) can enhance international mobility and eliminate the headache of identifying suitable banks to transfer salaries."

4.1.5 Verification of Medical and Criminal Records

The selection of qualified job candidates is not merely dependent on their technical and behavioral skills but also on checking medical and criminal records to verify their physical, mental and ethical suitability for the job. Blockchain has the potential to allow for secure sharing of medical and criminal records across different stakeholders.

Participant PT2 stated that "storing the employees' medical records on the blockchain will save a lot of time in verifying their health information records. We also face a lot of fraud from some employees; we have collectors who have forged medical records

and we discover this via the sudden collection of blood and urine samples; we discover that the employee is taking illegal drugs. Sometimes we get forged criminal records so it can be very beneficial to get data from its source (police records) via the blockchain."

4.2 Theme 2: Potential Adoption Challenges for Blockchain in HRM

The second emerged theme is related to the potential adoption challenges that may hinder the utilization of blockchain in HRM. The challenges reported by participants were as follows:

4.2.1 Lack of Support

The need for support of government, central bank, top management, and key organizational figures for successful embracing of blockchain adoption was elaborated on by several participants.

Participant PT3 stated that "if the organization's top management and key figures decided to adopt the blockchain, employees only alternative is to accept it rather than resist it." Participant PT9 said that "our organization is conservative to new technology adoption but if there is a market trend that is supported by the Central Bank of Egypt then we will all go after it." Participant PT6 illustrated that "whether blockchain will be implemented or not is dependent on whether the HRM department has mandate to change its current system to blockchain…the important question is whether the head of the organization supports blockchain utilization or not." Participant PT7 explained that "if the organization (top management) took the initiative to implement the blockchain, all employees will follow." Participant PT7 said that "having a governmental initiative will help organizations embrace the blockchain technology."

4.2.2 Lack of Worldwide Widespread Utilization of Blockchain Technology

Participants expressed reluctance to embrace blockchain unless it achieves widespread utilization via worldwide data sharing by governments and organizations to maximize adoption benefits.

Participant PT2 stated that "if the utilization of blockchain is widespread, this means that if I need data from the ministry of insurance or the police department for example, I will be able to find it on the blockchain uploaded by those parties." Participant PT6 stated that "the most important thing is for multinational institutions and banks to embrace the blockchain technology, he added that "blockchain is a dream for anyone but is it utilized? Is it utilized around the world by all the sectors? When this happens, it will be valuable. If airlines information, contracts and CVs are not in the blockchain, it will not be that valuable." Participant PT7 declared that "for me to benefit from the blockchain I need the largest number of parties to use it, otherwise why would I need it?" Participant PT8 reported that "the acceptance of all parties involved in blockchain to share their data is of utmost importance to its success …however, some data is not welcomed to be shared such as benefits and salaries."

4.2.3 Fear of Layoff

Participants perceived layoff as a consequence of blockchain adoption. Participant PT4 stated that "employees resist change due to the sense of job safety they enjoyed by staying in their comfort zone; they fear if such technology is used, they may be subject to being laid off." Participant PT6 emphasized such fear by stating that "any new software system leads to laying off some employees and recruiting others because old staff will resist the change to the new system since they worked with the old one for years. "Participant PT7 and PT8 also mentioned "layoffs" as underlying reasons that may cause resistance to blockchain adoption.

4.2.4 Lack of Competences

Lack of competence emerged as one of the factors contributing to employees' resistance to adopt blockchain technology. Participant PT3 stated that "employees may lack the knowledge and capabilities to embrace the blockchain". Furthermore, Participant PT7 stated that "Any change faces resistance but what is more significant is manpower ability …the ability of manpower can be a problem." Participant PT8 mentioned that "employees will need training" and Participant PT9 stated that "employees require training to adopt such emerging technology." Participant PT4 explained that "some employees are used to work with certain old manual ways; however, if blockchain technology is proved to be beneficial, they will embrace it."

4.2.5 Security Vulnerabilities

Participants were also concerned about security challenges resulting from blockchain adoption. Participant PT9 mentioned that "blockchain will be appealing to hackers, specially to know salaries." Whereas participant PT5 stated that "I can provide a budget for blockchain but I cannot jeopardize the data of clients and employees. I cannot store their data on the blockchain if there is a chance for its subjection to hacking."

4.2.6 Lack of Funding

Allocating funds was one of the administrative challenges for blockchain utilization. Participant PT5 stated that" I will compare the cost of blockchain implementation to the currently implemented system whether it is manual or automated… blockchain will be accepted if its budget is the same or less." Participant PT6 declared that "financial resistance is much more challenging than employees' resistance." Participant PT2 disagreed with participants PT5 and PT6; he mentioned that "any budget for blockchain tools can be guaranteed but the real challenge would be the data collection and verification before inclusion on the blockchain."

4.2.7 Need for Proof of Success

Participants voiced the need of witnessing evidence on successful blockchain adoption in other countries or organizations as an influential factor in embracing the technology. Participant PT7 stated that "the organization will embrace the blockchain technology after investigating its return on investment." Participant PT1 discussed his perspective concerning when Egypt will embrace blockchain by stating that "this will be a problem in

Egypt; blockchain will be utilized after witnessing its benefits in Europe and USA…. I am not convinced to use it until I witness a pilot implementation in other organizations that is fruitful." Participant PT4 reported that "If this technology is implemented abroad, it will be implemented in Egypt also."

6 Discussion

HRM encompasses diverse functions and sub-functions; recruitment and selection is perceived as one of the most profound HRM functions. Recruitment fraud is defined as a deception imposed by an employee regarding his educational background, work experience, or prior appraisals [18]. Recruitment fraud involves profound consequences, for example, hiring unqualified employees and damaging organization's reputation [18]. In 2017, the Risk Advisory Group inspected a sample of 5000 CV and the results revealed inconsistencies in 80% of CVs, overstatement of 21% job titles and 12% falsifications of grades [19]. Blockchain can be used for verifying educational credentials [15] and accordingly has the potential of tackling fraudulent applications.

The current research on blockchain HRM applications suffer from insufficiency of both empirical and theoretical studies as well as being focused on few areas, for example, blockchain impact on new jobs [17], blockchain benefits for the HRM process [17], proposal of an HR information management model for utilizing the blockchain [15], and blockchain utilization in verifying educational credentials [15]. This research has added to the body of knowledge an exploratory empirical study that resulted on shedding light on several potential areas of blockchain usage in the HRM domain. Those areas include performance appraisal, verification of references, verification of training centers and trainers' credentials, salary surveys and payment of employees' salaries, as well as verification of medical and criminal records. Those potential application areas can constitute a future research road map for both blockchain and HRM researchers.

Moreover, this study revealed several adoption drivers for blockchain technology including support of government, central bank, top management, and key organizational figures, worldwide utilization of blockchain, allocating funding, providing poof of success, dealing with issues that lead to employees' resistance to blockchain, for example, fear of layoff and lack of competences, and enhancing security measures.

7 Conclusion and Future Work

Blockchain offer a multitude of substantially impactful sector specific applications. This paper examined the results of an empirical study with HRM experts that resulted in pinpointing the potential opportunities and adoption challenges related to blockchain utilization in the HRM domain. The results of this study can act as a research agenda for blockchain and HRM practitioners and researchers who can utilize the use of the proposed opportunities as a future research agenda and work towards mitigating the anticipated adoption challenges.

Our future work will investigate the skills and competencies that HRM experts must possess in order to utilize the blockchain technology in HRM applications. Moreover, we plan to examine the set of new HRM jobs that may evolve as a result of blockchain as well as working towards implementing an application for HRM practices that benefits from blockchain technology.

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