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Applicability of Blockchain Technology in Cadre Personnel File Management

Zhenxiong Zhang

Jiangxi Normal University, Nanchang, 330022, Jiangxi, China

Abstract: *Cadre personnel file management has faced issues such as falsification, tampering, and loss of materials for a long time, due to the insufficient staffing of archive management personnel and difficulties in collecting scattered archival materials. The anti-tampering, multi-party collaboration, and full-process traceability characteristics of blockchain technology highly align with the demands of cadre personnel file management. The article systematically analyzes the applicability of blockchain technology from six dimensions: normative basis of cadre personnel file management, management practice, governance system, security system, resource system, and utilization system. Furthermore, it proposes a technical solution based on "alliance chain architecture + hierarchical data storage + smart contracts", aiming to build a cadre personnel file management model with clear responsibilities, traceable processes, and secure sharing. Given that blockchain is currently at the pilot stage, future efforts should focus on establishing unified standards and norms, deepening the integration of technology and business, creating a scientific architecture that balances security and privacy, and providing technical support for scientific, standardized, and modernized archive management.*

Keywords: *Cadre Personnel Files, Blockchain Technology, Applicability Analysis*

1. Introduction

Cadre personnel files are historical record materials reflecting a cadre's political quality, moral conduct, ideological understanding, educational and work experience, professional competence, work style, work achievements, integrity and self-discipline, law-abiding behavior, as well as family status and social relations. As professional archives, they possess characteristics such as collectivity, authenticity, actuality, and dynamism. The formation period of cadre personnel files is relatively long, starting from the subject's enrollment in junior or senior high school and continuing until death, spanning six to seventy years. Corresponding archival materials are required to be filed and preserved during schooling, work, and even after retirement, reflecting the dynamic nature of cadre personnel files. The archival materials are classified into ten major categories with diverse types and sources. Therefore, their management methods differ from other types of archives. In recent years, frequent issues such as falsification, tampering, and loss of materials in cadre personnel files have emerged; at the same time, low efficiency in filing scattered materials and excessive workload have troubled archive managers for a long time.

With the advancement of archival informatization, emerging technologies have provided possibilities to solve the aforementioned difficulties. Leveraging the advantages of distributed ledgers and databases, blockchain technology has received widespread attention in recent years. In 2020, the National Archives Administration explicitly proposed promoting the application of blockchain technology in archive management. Recently, multiple archive management departments have actively applied blockchain technology in archival management practices and achieved significant results.

The anti-tampering, multi-party collaboration, and full-process traceability features of blockchain technology highly align with the authenticity, dynamism, and security requirements of cadre personnel file management. The article aims to analyze the applicability of blockchain technology in cadre personnel file management and to construct a practical model.

2. Challenges in Cadre Personnel File Management

2.1 Issues of Material Falsification, Tampering, and Loss

Under the policy guidance and strict requirements of "mandatory review upon entry and promotion"

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and “full coverage of cadre personnel file review”, the frequency of cadre personnel file access and review has significantly increased, with corresponding management standards continuously rising. However, frequent review processes have revealed some prominent issues in cadre personnel file management that urgently need resolution, mainly manifesting as missing archival materials, suspected falsification of materials and information alteration. The existence of these problems severely undermines the authenticity, integrity, and authority of cadre personnel file information, posing potential threats to the fairness of cadre selection, appointment, and management supervision.[1]

2.2 Insufficient Staffing of Archive Management Personnel

Article 16 of the “Regulations on the Management of Cadre Personnel Files” stipulates: “Generally, one full-time staff member should be assigned for every 1,000 volumes of files managed.” However, most units fail to meet this basic staffing requirement. The shortage of full-time personnel directly leads to an excessive workload and abnormal burden on cadre personnel file management staff. Under this condition of too few people handling too many tasks, timely archiving of materials is often difficult to ensure, and the quality of filing work inevitably suffers, making effective guarantees difficult to achieve.[2]

2.3 Difficulties in Collecting Scattered Archival Materials

The long time span and dynamic nature of cadre personnel file materials require continuous collection of newly added materials such as annual evaluation forms, salary approval forms, professional title evaluation materials, appointment and removal documents, etc., which is a key focus of archive management staff. However, the functional departments generating these materials often fail to archive them timely and completely due to insufficient archival awareness, delayed filing, or self-retention, placing great pressure on cadre personnel file management.

Currently, most newly added scattered materials originate from routine business activities of organizational and personnel departments. It is noteworthy that these departments have already used their respective business systems to complete related workflows. Therefore, the generated archival materials can be directly produced as electronic versions from these systems. At present, cadre personnel files adopt a “dual-set” archiving and preservation mode, with the specific operational process as follows: First, physical paper-based scattered materials must be collected. Second, they are meticulously classified, numbered, and sorted manually. Third, the organized paper materials are digitized through scanning to create electronic copies. Finally, the well-organized paper materials are placed into corresponding personnel archive boxes for proper storage. For a long time, manual addition of scattered materials has carried potential risks of negligence during insertion. Coupled with the possibility of individuals sharing the same name within a unit, this easily leads to material confusion, resulting in mistakenly filing scattered materials into the wrong person’s archive, ultimately producing “misattributed” archival materials.[3]

3. Applicability Analysis of Blockchain Technology in Cadre Personnel File Management

3.1 Adaptability to Normative Basis

Article 21 of the "Regulations on the Management of Cadre Personnel Files" issued by the General Office of the CPC Central Committee in 2018 explicitly states that the informatization of cadre personnel files is part of daily management. Article 23 further clarifies the work requirements for digital technology standards and digital processes in cadre personnel management.[4] Institutionally, this clarifies the developing trend of digital management of cadre personnel files, which will provide application scenarios for blockchain applicability from a regulatory perspective and establish a system foundation for promoting digital governance of archives.

3.2 Feasibility in Archive Management Practice

Since 2020, under the national-level promotion of blockchain technology, numerous archive management units have been actively explored and experimented with its application. For example, Anhui Baohulu Group developed the G6 blockchain archive application system targeting various types of archive management units, creating an open API platform for archive blockchain. The construction of this platform is of significant practical importance for accelerating the strategic transformation of archival

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informatization, deeply advancing the digitization of traditional carrier archives, strengthening electronic file archiving and electronic archive management, building digital archives (rooms), and achieving the goal of archive management modernization centered on informatization. Meanwhile, Liaoning Province has focused on establishing a blockchain-based livelihood archive system alliance aimed at realizing trusted cross-agency archive sharing and convenient verification.[5] These initiatives successfully appllied blockchain technology to specific archive management business scenarios, deeply exploring its application potential and providing valuable successful cases for the broad implementation of blockchain technology in the archival field.

3.3 Synergy of the Archive Governance System

The "14th Five-Year National Archive Development Plan" introduces the concept of archive governance, adding an archive governance system based on the archive resource system, archive utilization system, and archive security system. The so-called "archive governance system" refers to the institutional arrangements and operational processes led by archive departments, with broad participation from social organizations and citizens, to plan, organize and coordinate archival affairs under the principles of democracy and rule of law.

Cadre personnel file management should also be led by archive departments, with proactive participation from various archiving units, forming an effective archive management mechanism to jointly govern the three major archive systems. By constructing multiple blockchain blocks, archive management departments, archival material filing units, and personnel archive utilization units are set as network nodes to jointly build and share a distribution network. These nodes are linked on the blockchain, enabling departments to collaboratively build archive resources, facilitate archive utilization and jointly maintain the authenticity, integrity and security of archives. This contributes to the construction of the archive governance system and helps achieve resource integration, utilization optimization, and joint security governance.[6]

3.4 Strengthening of the Archive Security System

The core goal of building the archive security system is to comprehensively ensure the security of the physical archives and the information they carry. A significant advantage of blockchain technology lies in its ability to effectively guarantee data security and immutability. By constructing a distributed ledger mechanism, the technology ensures that once data is recorded on the blockchain, it cannot be unilaterally altered or deleted, thereby providing strong protection against malicious modification and forgery of archival content. Meanwhile, blockchain technology applies advanced encryption algorithms to protect sensitive information within archives, ensuring that only strictly authorized personnel can access the relevant information. Empowered by blockchain technology, key security issues such as tampering with archival content and unauthorized leakage of archival information can be effectively resolved at the technical level, thereby building a more solid and reliable technical defense line for the archive security system in electronic environments and further reinforcing archive security.

3.5 Completeness of the Archive Resource System

The key to building the archive resource system lies in achieving the goal of "collecting all that should be collected and archiving all that should be archived." However, since archive management departments often occupy relatively marginalized positions, the importance attached to archival work by relevant business filing departments is generally insufficient. This directly leads to delayed or overdue archiving work and cases where some archival materials are self-retained rather than submitted. These situations have severely affected the completeness and systematization of the archive resource system. By introducing blockchain technology to build a trusted platform, all departments must promptly archive completed archival materials through this system. Each archiving action will generate detailed, tamper-proof operation records, greatly facilitating the tracking and auditing of operational history. Moreover, the system can automatically trigger warning mechanisms for materials not archived within the prescribed timeframes, effectively reminding responsible personnel to carry out archiving operations.[7]

3.6 Convenience of the Archive Utilization System

Cadre personnel files, as an important foundation for education and training, selection and appointment, management supervision of cadres and talent evaluation, have received increasing attention,

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with rising frequency of use. The blockchain-based permission system uses public key encryption and hash functions to set security barriers for electronic archives, ensuring that authorized personnel can access files over the network, thereby improving archive utilization efficiency. Each file modification triggers the creation of a new block linked to the previous one via its hash value and timestamp. This chain structure deters unauthorized alterations and ensures the integrity and security of digital archives.

In summary, from the perspective of the compatibility of management regulations and technical standards, as well as the coordinated construction needs of four major systems—the archive resource system, security assurance system, efficient utilization system, and full-process governance and supervision system—blockchain technology is applicable to the current personnel file management scenarios under digital transformation. This technology can provide solid and reliable technical support and innovative impetus for building a more standardized, secure, efficient, and trustworthy modern archive management system.

4. Construction of a Cadre Personnel File Information Management Platform Based on Blockchain Technology

Drawing extensively on advanced domestic and international cases, a blockchain-based archival management platform is constructed. This platform employs an integrated technical solution of "alliance chain architecture + hierarchical data storage + smart contracts" to build a cadre personnel file management model with clear responsibilities, traceable processes, and secure sharing. It ensures the originality, authenticity, integrity, and long-term preservation of archives, achieves offline archival information linkage, online archiving traceability, and secure, compliant cross-agency utilization, facilitates daily archiving and access, and guarantees that archival information is authentic, complete, and tamper-proof.[8]

4.1 Selection of Blockchain Type

Blockchain can be classified into public, private, and alliance chains. Given the characteristics of cadre personnel file management, the alliance chain model is more suitable; it allows joint maintenance by multiple organizations, requires permissioned node access, and enables secure archive collection and utilization on the blockchain. Referencing the Hyperledger Fabric system, a blockchain framework is built by deploying blockchain nodes, with the cadre personnel file management system, personnel work management system, and organizational work management system operating as blockchain nodes.

4.2 Hierarchical Storage Mechanism for Basic Data

The construction first establishes hierarchical data storage, including on-chain and off-chain storage. On-chain storage only retains key "metadata" of cadre personnel files, including the internal directory of personnel files, creation time, basic personnel information, and hash values. Storing basic personnel information serves unified identity authentication for future personnel file access and archiving, while hash values act as proof of the immutability of archive content. Off-chain storage digitizes paper personnel files through a professional personnel file management system, converting them into image files stored within the personnel file system.[9]

4.3 Construction of the System Application Layer

The system application layer is built to provide operational support for organizational personnel departments in archiving and file access. Organizational personnel departments can regularly archive newly generated archival materials from their business systems into the cadre personnel file system. This operation requires consensus confirmation from both the organizational personnel department and the archive management department, and is timestamped. Through unified personnel identity authentication, scattered materials are matched one-to-one with the corresponding file subjects, and materials of individuals with the same name are identified to avoid misfiling. The archiving operation triggers the recording of archive information and metadata on the blockchain, ensuring the security, reliability, and traceability of archival materials. On the other hand, based on cadre personnel file utilization regulations, an archive utilization platform is constructed. Users must follow established access procedures to inquire about relevant archival information through the platform.

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4.4 Design and Development of the Smart Contract System

A smart contract system fully compliant with cadre personnel file management requirements is designed and developed. Its core functions include centralized management of archive metadata, secure storage and real-time verification of file hash values, immutable and permanent recording of all access operations, and immutable and complete recording of all archiving processes, supplemented by a business archiving notification and reminder mechanism. The construction and implementation of this intelligent platform effectively address the long-standing difficulties and pain points in cadre personnel file management.

5. Conclusion

As an emerging technology, blockchain has seen numerous applications and achieved notable progress in archival management. However, most implementations remain at the pilot or experimental stage. The absence of unified technical standards, operational norms, and management systems across the industry has created a 'no rule to follow' dilemma, hindering large-scale standardized adoption. Nevertheless, blockchain's unique value for cadre personnel file management grows increasingly evident, offering irreplaceable advantages in data security/confidentiality, information credibility/integrity, and management efficiency/utilization ease. Future development must prioritize accelerated standardization of regulatory frameworks, deeper technology-business integration, and architectures balancing security with privacy protection. Ultimately, blockchain holds revolutionary potential to enhance the security, authenticity, and accessibility of cadre personnel files — providing robust technical support for scientific, standardized, and refined archival management in service of the 'four archival systems' construction.

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