



# Reflections on the Application of Blockchain Technology in Geological Survey Project Management

Xiang Wei<sup>1</sup>, Jianli Qian<sup>2,3,\*</sup>, Cheng Ma<sup>1</sup> and Weiwei Cao<sup>4</sup>

<sup>1</sup> Development Research Center, China Geological Survey, Beijing 100037, China

<sup>2</sup> Xi'an Mineral Resources Survey Center, China Geological Survey, Xi'an 710000, Shaanxi

<sup>3</sup> School of Environment, China University of Geosciences (Wuhan), Wuhan, 430074, Hubei

<sup>4</sup> Urumqi Natural Resources Comprehensive Survey Center, Urumqi 830026, Xinjiang  
939807044@qq.com, 1228143523@qq.com, 32210591@qq.com, 792006716@qq.com

\*Corresponding author. E-mail address: 1228143523@qq.com (J L Qian)

## ABSTRACT

Blockchain is a combination of distributed data storage, smart contracts, peer-to-peer transmission, consensus mechanisms, cryptographic algorithms and other means to form an innovative technology, with decentralized, not easy to tamper, the whole trace, traceable, collective maintenance, open and transparent characteristics, in project management has a very important potential value. This paper comprehensively compares the development stages of blockchain technology, describes its application scenarios, and analyzes the needs faced by geological survey project management under the new situation. n this basis, the general idea of applying blockchain technology in geological survey project management is proposed, as well as four key tasks of building a credible blockchain alliance mechanism for geological survey projects, building a collaborative innovation system with the joint efforts of multiple parties, integrating and integrating existing functions based on blockchain technology and exploring the use of blockchain technology to build a scientific research integrity information system, It is expected to provide theoretical guidance and reference for the application of blockchain technology to promote intelligent and accurate management of geological survey projects.

**Keywords:** Blockchain; geological survey; project management; consortium mechanism; collaborative innovation.

## 1. INTRODUCTION

Blockchain is an innovative technology formed by a combination of distributed data storage, smart contracts, peer-to-peer transmission, consensus mechanism, cryptographic algorithms and other means, with the characteristics of decentralization, not easy to tamper, full trace, traceable, collective maintenance, open and transparent. These features ensure the "honesty" and "transparency" of the blockchain and provide the foundation for the blockchain to create project management [5].

The Decision of the Central Committee of the Communist Party of China on Several Major Issues Concerning Adhering to and Improving the Socialist System with Chinese Characteristics and Advancing the Modernization of the State Governance System and Governance Capability, adopted at the Fourth Plenary

Session of the 19th CPC Central Committee, states that the modernization of the state governance system and governance capability should be fully realized "by the one hundredth year of the founding of New China", It has unique advantages in promoting the flattening of social governance structure, transparency of governance and service process, and improving the credibility and security of government social governance data. According to statistics, 36 blockchain policies have been introduced across the country in November 2019 alone [3]. So far, more than 30 provinces and cities have issued blockchain support policies, more than 30 universities have offered blockchain-related courses, and hundreds of blockchain funds and more than 6,000 technical and industrial alliances have been established. The application of blockchain has expanded from digital currency at the beginning to digital finance, Internet of Things, smart manufacturing, supply chain management, digital asset trading and many other fields [4] [6].

Based on this, it is necessary to have a comprehensive and rational understanding of blockchain and explore the formation of a systematic and reasonable project management mechanism for geological survey, so as to promote the healthy and rapid development of geological survey.

## 2. BLOCKCHAIN TECHNOLOGY DEVELOPMENT STAGE

The earliest application of blockchain technology is Bitcoin. Blockchain, which is the core of Bitcoin technology, is a pervasive underlying technology framework, and its development has roughly gone through 3 stages, as shown in Figure 1.

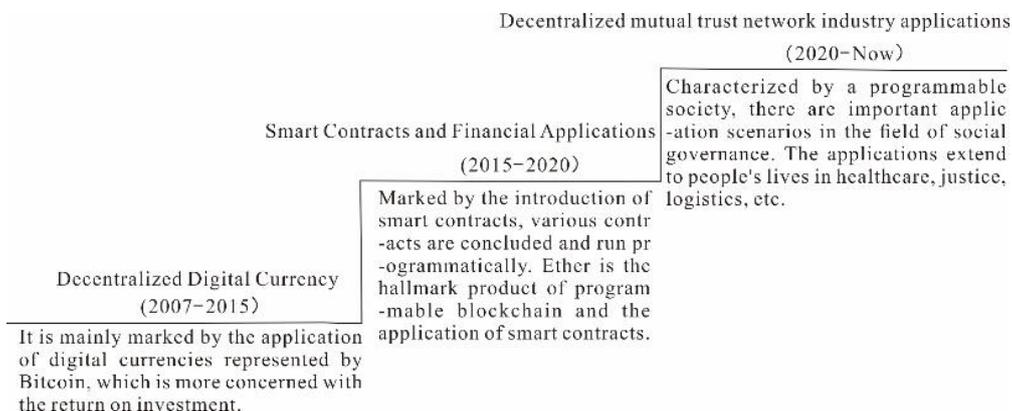


Figure 1 Blockchain technology development stages

### 2.1 Decentralized Digital Currency Phase (2007-2015)

Initially blockchain was a cryptographically secure distributed ledger with features such as easy verification and tamper-evident, typically marked by the application of digital currency represented by Bitcoin. At this stage, people don't notice the value of blockchain technology and focus more on the ROI of digital currencies. At the same time, the 10,000 bitcoin for two pizzas event, which links virtual currency to real physical objects, is a milestone for the development of blockchain technology.

### 2.2 Smart Contracts and Financial Applications Phase (2015-2020)

Marked by the introduction of smart contracts, various contracts are concluded and run programmatically, providing more flexible contract functions in addition to monetary transaction functions, greatly improving the flexibility of blockchain technology and providing a reliable execution environment for smart contracts. At this stage, Ether is the hallmark product of programmable blockchain and the application of smart contracts. It is an open source public blockchain platform with smart contract capabilities that provides a centralized Ether VM to handle peer-to-peer contracts through its dedicated cryptographic Ether.

### 2.3 Decentralized mutual trust network industry application phase (2020-present)

Characterized by a programmable society, there are important application scenarios in the field of social

governance. The scope of application has extended beyond the financial field to the medical, judicial and logistic fields in people's lives. Blockchain can solve the problem of trust, people no longer need to rely on a third party to obtain or establish trust, and has the potential to become a kind of underlying protocol for the "Internet of Everything". In this phase, blockchain technology will go far beyond the realm of cryptocurrency, payments and financial economics. It is the recognition, measurement and storage of property rights to the information and bytes that represent value in every Internet hub, reshaping every aspect of people's lives.

## 3. BLOCKCHAIN TECHNOLOGY APPLICATION SCENARIOS

### 3.1 Blockchain + Government Management

According to statistics, as of February 2019, a total of 14 provinces and cities, including Beijing, Shaanxi and Shandong, are making or preparing to make attempts related to "government affairs + blockchain" [2]. Blockchain technology applies to e-government scenarios as shown in Figure 2, which are widely used mainly in the fields of electronic certificates, real estate registration, common business registration, bidding and poverty alleviation.

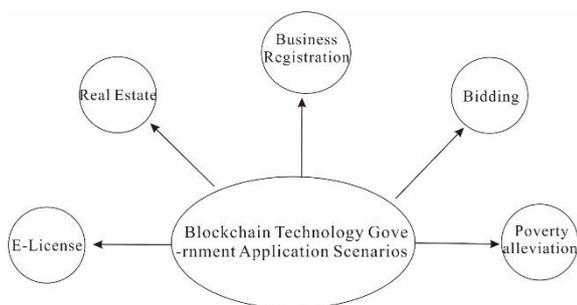


Figure 2 Blockchain technology for e-government scenarios

### 3.2 Blockchain + Project Management

Blockchain has been applied in the field of construction project construction management, mainly in various aspects such as construction bidding, construction quality control, construction cost control, construction safety management, construction contract management, construction information management, green construction (environmental protection) and engineering insurance [1], and has achieved better practice and experience in the field of blockchain technology in realizing the whole process of project management.

### 3.3 Blockchain + Integrity Management

It is applied in building integrity management platform and closed-loop integrity control system, for example, Qingzhen, Guizhou uses the tamper-evident feature of blockchain technology to record, collect, improve and integrate the credit information generated by government departments in the process of performing public management functions, as well as the information collected by rural areas according to village rules and regulations. Through the use of scenarios of the platform, the construction of a fusion of shared government system, to promote the formation of social credit system interconnection, collaboration and sharing, and can quickly and at low cost to form a new situation of joint application of big data.

## 4. THE NEED OF GEOLOGICAL SURVEY PROJECT MANAGEMENT

Since 2018, geological survey project management has been actively implementing the requirements of "management and service" and achieved remarkable results. However, in the face of the upgrade of the China Geological Survey to a central budget unit, the "three transformations" of geological survey and the demand-oriented, problem-oriented and goal-oriented measurement standards, new demands are made on the project management of geological survey. On the one hand, the implementation of the "trinity" of cloud platform, big data and intelligence of geological survey project informationization proposed by the Party Group

of China Geological Survey, the promotion of blockchain and other technologies applied to the construction of intelligent project quality assessment and scientific research integrity system, and the promotion of innovation of related technologies are inevitable requirements to improve the construction and management level of geological survey project management system in the context of big data. Promoting the application of blockchain technology in project management in the natural resources sector is also an important element of modernizing the country's governance capacity. On the other hand, in the current project management system, expertise, artificial intelligence and blockchain have become the inevitable development direction and innovative ways of project management in the future. The blockchain technology, through the storage and management mode of distributed ledger, provides the possibility of changing the organizational structure of geological survey projects from star-like to net-like, and the project management gets rid of subjective factors and goes data-oriented and intelligent.

## 5. REFLECTIONS ON THE APPLICATION OF BLOCKCHAIN TECHNOLOGY IN GEOLOGICAL SURVEY PROJECT MANAGEMENT

### 5.1 General idea

Based on the results of "Geological Cloud", we will use blockchain technology to establish a data sharing protection system and build a credible blockchain public service platform for geological survey based on the principle of mixing public and private chains. The public chain mainly emphasizes on up-chain joining, such as the national integrity system, facilitating access to relevant qualifications of cooperation units, financial units (electronic invoices, reimbursement process, automatic association of scientific research projects), while the private chain mainly takes the units belonging to the Bureau of China Geological Survey as nodes, relies on the geological survey business network, takes geological survey project management as a grip, breaks the barriers between levels and departments, optimizes geological survey resource management and configuration, realizes collaborative and accurate management of geological survey projects, realizes data sharing, determination of rights, responsibilities and controlled flow throughout, and further promotes geological big data for geological survey business support services.

## 5.2 Key tasks

### 5.2.1 Building a Trusted Blockchain Federation Mechanism for Geological Survey Projects

Adhering to the principles of complete openness, transparency, justice and fairness within the private chain of the whole Bureau, the Trusted Blockchain Alliance Mechanism for Geological Survey Projects is constructed for all units belonging to the China Geological Survey and relevant cooperative units, and the corresponding nodes and permissions are set according to the general deployment plan of the nodes of the Trusted Public Information Service Platform for Geological Survey. Among them, the relevant node settings are shown in Table 1.

Table 1 Project management alliance institutions and corresponding node settings

Chain Nodes	Composition	Information Granularity
Level 1	Bureau units	Detail Level
Level 2	Secondary Projects	Medium Level
Level 3	Project Partners	Coarse grade
Level 4	Experts	Coarse grade
Level 5	Project members	Detail Level

### 5.2.2 Multi-party cooperation to build a collaborative innovation system

The application of blockchain technology is a systematic project that requires the cooperation and coordination of various parties to promote effectively. However, it is difficult to balance the node size, performance and fault tolerance, difficult to achieve cross-chain interconnection, lack of unified standards, and difficult to ensure consistent data on and off the chain due to the existence of problems. In response to the above problems, stakeholders, including chain participants and technology providers, need to coordinate the planning and participate in the construction of a collaborative innovation system for blockchain technology. In terms of technological innovation, due attention should be paid to the integrated innovation of blockchain and artificial intelligence, Internet of Things, big data and other new generation information technology, to avoid the "silo" development of various emerging technologies, to give full play to the role of the existing geological cloud

platform, to avoid duplication of support and construction, and to improve the intensive effect.

### 5.2.3 Integration of existing functions based on blockchain technology

Blockchain technology, when well mastered and used, can significantly improve the efficiency of geological survey project management, reduce management costs, optimize management mechanisms, support innovation and development, and become an important grip for modernizing the governance system and governance capacity. On the basis of multiparty cooperation to build a collaborative innovation system, through cross-level and cross-departmental data interoperability and trustworthy environment, to achieve data resource sharing, unified business processing portal, to achieve refined management, to avoid duplication of basic data entry, to avoid duplication of audit, to promote the project business whole life cycle online, collaborative, "one network to do" type of management, reduce costs, improve quality and efficiency, and promote the transformation of functional services. It adopts peer-to-peer encrypted transmission, "smart contract" for quick approval and records of data invocation, encrypted information security, transparent traceability and clear definition of rights and responsibilities to create an honest and good ecological environment for geological work. We focus on key core technologies such as blockchain data model, storage method, cross-network interconnection and migration and deployment of existing project management system, data structure conversion and up-chaining. The integration of existing management requirements with blockchain integration and on-chain recommendations are shown in Table 2.

Table 2 Integration of existing functions and assumptions on chaining

Functional integration concept	Uplink Scenario
Blockchain+Project Review	Expert system construction and up-linking
Blockchain+Outsourcing Management	Enterprise integrity on the chain, smart contract construction
Blockchain+Project Budget Management	Financial management certain authority control under the uplink
Blockchain+data remittance	Up-linking under certain authority control of the remittance system

Blockchain+Data Sharing	Geological cloud online system under certain authority control of the uplink (desensitization process)
Blockchain+Notes	Financial reimbursement, contract funding allocation under certain authority on the chain (public and private chains)
Blockchain+Project Acceptance	Project results (major discoveries, reports, papers, patents, data auto-linkage system construction) up-linking (desensitization) under certain authority control, traceability; expert system up-linking

### 5.2.4 Exploring the use of blockchain technology to build a research integrity information system

In-depth implementation of "blockchain +" action, explore the application of blockchain in the field of geological survey project management, especially in the application of scientific research integrity system construction. Reasonable layout according to three major segments: infrastructure (blockchain service network, blockchain and service platform, etc.), industry field applications and comprehensive services, exploring the use of blockchain technology to build a research integrity information system. In accordance with the current "Geological Survey of China Geological Survey and Scientific Research Project Integrity "Blacklist" Management Measures (for trial implementation)", to build a database of project leaders and project team members of affiliated units and units entrusted by the China Geological Survey, geological surveys and scientific research, as well as experts who carry out project management, provide project consultation, evaluation, supervision and other activities in breach of trust. Strengthen research integrity information management and research integrity information sharing application, make "smart contract", carry out "data autonomy", make research integrity management fair, just, open, transparent and efficient.

## 6. CONCLUSIONS

Blockchain has set off a boom of innovation and reform in many areas of people's lives because of its many technical advantages. In recent years, the state and local governments have also promulgated a series of policies to boost the rapid implementation of blockchain technology. However, it should also be fully recognized that technology itself is not omnipotent, the improper use

of new technology or loss of control, not only will not bring positive effects to the improvement of governance capacity, but also lead to misguided technology deformation under the gradual change, will bring profound challenges to the modernization of the governance system and governance capacity. At present, the traditional centralized supervision mode is difficult to adapt to the inherent technical requirements of blockchain, and the application of blockchain also puts forward higher requirements on the utilization and proficiency of new technologies and the modernization of administrative ideology. Therefore, when better promoting the application of blockchain in geological survey project management, it is also necessary to transform and strengthen the administrative management concept change and related capacity enhancement.

## ACKNOWLEDGMENT

This paper is funded by the project "Geological Survey Standardization and Standard Revision (2022-2025)". (No.: DD20221826).

## REFERENCES

- [1] Gao G-W, Gong P-L, Li Y-X. Research on the collaborative sharing model of government basic information based on blockchain[J]. E-Government, 2018(2):15-25.
- [2] Jiao D, Liang Z. Research on security protection of government information resources sharing and exchange based on blockchain[J]. Network Security Technology and Applications, 2019(06):114-115.
- [3] Wu Tong. Blockchain: an enterprise organization and management revolution [J/OL]. China-Europe Business Review, 2018(7):20-26.
- [4] Wang M-L, Lu J-Y. Research on blockchain technology and its application in government governance[J]. E-Government, 2018(02):2-14.
- [5] Yao, Z.-J., Ge, J.-G. A review on the principles and applications of blockchain[J]. Research Information Technology and Application, 2017, 8(02):3-17.
- [6] Zhou, Lisa, Kong, Yongping, Lu, Gang. Exploring the application of blockchain in digital government [J]. Guangdong Communication Technology, 2018, 38(10):7-9.

**Open Access** This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

