The Application of Blockchain Technology in E-government in China

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***Abstract*—The purpose of this article is to discuss the application of blockchain technology in e-government, particularly in the Chinese context. Chancheng District, part of Foshan City in Guangdong Province, China, has undertaken a project called "The Comprehensive Experimental Area of Big Data in Guangdong Province" since 2016. Promoting the application of blockchain technology in e-government is an essential part of this undertaking, which is the first use of blockchain in government in China. Taking Chancheng's project as a case study, this article analyzes the framework, difficulties and challenges of applying blockchain to e-government at present, and discusses how blockchain technology can contribute to the development of e-government and public services in China. This article considers the practical realities in China and discusses the application of blockchain technology in Chinese e-government, finding that blockchain technology can bring the following benefits: (1) improvements in the quality and quantity of government services, (2) greater transparency and accessibility of government information, (3) development of information-sharing across different organizations, and (4) assistance in building an individual credit system in China. However, information security, cost and reliability are still major problems in application. Thus, establishing a general application platform of blockchain technology and developing management standards are crucial for promoting and applying blockchain in e-government. Blockchain provides an effective way of making government services more efficient, but standardizing the management system, processes and responsibility for the application is necessary for its further promotion. This article, by providing an analysis of the practice of blockchain in e-government in China, could serve as a foundation for further practical work and theoretical research in government services.**

Keywords— blockchain; e-government; public services; China

I. INTRODUCTION

Blockchain technology, which was first proposed by Satoshi Nakamoto in 2008, has been the subject of much attention in many countries and different fields in recent years. Although "Satoshi Nakamoto" proved to be a pseudonym and no one knows his actual identity, Nakamoto's work is being used all around the world.[1] Generally, blockchain is defined as a distributed ledger that maintains a continually growing list of publicly accessible records cryptographically secured from tampering and revision.[2] It is believed to create a persistent, immutable, and ever-growing public ledger that can be updated (i.e., by appending information using cryptographic digital signatures) to represent the latest state of a blockchain.[3] It was originally used to record historical transactions of encrypted digital currencies such as Bitcoin.[4] At present, the application of blockchain technology has been extended to the Internet of Things, intelligent manufacturing, supply chain management, digital asset transactions, and other fields.

In 2016, the Chinese government published a white paper on the development and application of blockchain technology in China that discussed the core technologies and typical applications of blockchain, put forward suggestions for technological development, and standardized the use of blockchain in different sectors in China. The Chinese government has long been striving to promote the development of e-government by using information communication technologies (ICT) in the public sector to accelerate administrative transformation. The use of blockchain technology in e-government systems is part of this development; it is necessary to discuss the relevant key issues.

II. THE APPLICATION PROJECT OF BLOCKCHAIN TECHNOLOGY IN CHINESE E-GOVERNMENT

In 2016, Chancheng District (part of Foshan City in Guangdong Province, China), established the "Guangdong Province Big Data Comprehensive Experimental Area." The Chancheng government collaborated with a software company called 21ViaNet China Inc. to establish the first e-government service platform using blockchain technology in China. Donghao LIU, Chief Executive of the Chancheng District Party Committee, said that in order to develop informatization construction, information security and credit guarantees are essential. Fortunately, blockchain technology can have the effect of ultimate proof. Therefore, Chancheng government has built a next generation open-operation platform that is based on blockchain technology which will enhance mutual trust between government, enterprises and citizens.[5]

This project is based on the foundation of One-Stop Services in Chancheng Distict, which started in 2014 and set up different government institutions so that citizens can apply for multiple public services through the same platform instead of searching and applying for different services on different platforms and at different institutions. According to the Strategic Cooperation Agreement, the application of

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blockchain technology in Chancheng's e-government focuses on two goals:

(1) Solving the problem of individual credit by building a digital identity system. Chancheng government believes that using blockchain technology to preserve all system records of changes and trading on a cloud system can verify the provenance and authenticity of data during transmission.[6] In this way, it is possible to establish a reliable personal identity system. The digital identity includes personal identity authentication and digital signature functions and will provide reliable identification of individuals as a basic part of One-Stop Services.

(2) Disclosing reliable information related to people's livelihood. At present, Chancheng government applies blockchain technology to food safety, using an application called the Smart Farmers Market. It contracts with 73 farmers' markets, uploading and disclosing the products' testing data during their production, transportation and marketing processes, ensuring the quality and safety of the edible agricultural products.

As shown above, Chancheng government applies blockchain technology to solve problems of identity, credit, and information disclosure. And this project will be extended to building an enterprises credit system and a blockchain-based platform that includes enterprises, consumers and suppliers, so that consumers can be informed of the background of enterprises, and enterprises can know more about the demands of consumers and the reliability of suppliers. It will also collaborate with high-tech companies to develop more blockchain-based applications apply to different public services, including elder services clouds, healthcare, pensions, government performance, food safety and government divisions, all of which have close relationships with individuals' livelihood.

III. THE ADVANTAGES OF APPLYING BLOCKCHAIN TECHNOLOGY TO E-GOVERNMENT IN CHINA

In China, e-government development is considered an important component of the national informatization strategy. Although a lot of money, technology, and human resources will be invested in this area, applying a new technology to government services is greatly complicated by the sheer size of the population and the complex demands on public services. The government sees blockchain as a potential solution to these challenges, because blockchain itself is secure against online attacks, can be verified by anyone, and is resistant to any attempt to tamper with its history.[7] It is hoped that blockchain can be used to help to set up individual accounts to access government services and improve governance, an area of high need due to the large migrant population in Chancheng District. Moreover, blockchain-based platforms can be used to give citizens access to reliable government information, which can in turn strengthen the government's credibility.

A. Improving the Quality of Government Services

When using blockchain technology, any individual certificates, material objects, property and personal records, and even public records, can be recorded on the same platform, providing each object a permanent digital identity. This system will provide each citizen with "individual credit" and a verifiable digital identity, stored immutably in the blockchain platform. In this situation, government will rely on individual credit records rather than other conditions to provide public services, which will simplify bureaucratic processes and improve the speed and authority of government approval. It can also help to reduce administrative bias, ensuring everyone is able to access public services equally.

B. Developing the Individual Credit System

In China, personal records are separately stored in different systems. For example, education records and employment records are preserved in individual institutional archives, while identification information and permanent registered records are stored in the local Public Security Bureau. Other records, including marriage records, are held in the local Civil Affairs Bureau. This fragmentation makes it challenging for individuals to collect all the necessary personal records when they need to apply for public services. Using blockchain technology to establish an individual credit system means that all these personal records can be preserved in the same system so that every individual will have a comprehensive digital identity, including all of their personal records, which contains reliable, authoritative personal information and cannot be changed arbitrarily. The Chanchen District Government plans to distribute individual digital identity cards, which will authorize citizens to use the blockchain-based public services platform, and will provide them with access to their records and personal information. Accordingly, the government and other institutions will rely on the records in digital identity cards to make decisions. The long-term vision is that citizens will then value their individual credit, which will play an important role and not be able to be changed at random, and try their best to maintain good credit. This will also benefit the government's governance and social harmony.

C. Strengthening the Government's Credibility

The functions of government include economic management, market supervision, social management and public service. Open government means that the information related to the public is made accessible to citizens, and individuals can supervise the government's work. An open government that relies on unchangeable information in a blockchain system brings more than just convenience to the public. Transparency breeds trust, and when individuals can trace the provenance of any particular information that impacts their life, as in information related to food safety, they are more likely to have faith in it. Thus, by endorsing blockchain technology, the government can strengthen their authority and credibility with the public, and thereby govern more effectively.

D. Promoting the Integration of Resources

On the one hand, although China remains a unitary political system, it is one of the most decentralized countries in the world in terms of the resources and responsibilities assigned to local governments.[8] This makes the integration of resources from different governmental bodies extremely challenging.

The hope is that blockchain technology can help solve this challenge. Within the blockchain system, every transaction is recorded, which makes it easy to trace the parties authorizing transactions and understand scope of the transaction. It also means that data can be more easily and safely transferred between different organizations, thus promoting the integration of information amongst different organizations.

On the other hand, the blockchain-based platform has high scalability and it depends heavily upon a consensus mechanism. This means that government can set up different enterprises that meet the conditions of the blockchain-based platform and select nodes that add to the chain through a consensus algorithm. By using a consensus mechanism, government can build trust between different enterprises, establish blockchain-based applications that can provide more diversified public services, and the resources across different enterprises can be integrated into a single platform. Like the Smart Farmers Market in Chancheng, each market that meets the conditions can join in the chain, and provide testing information from their products. This will form a database of complete testing data of the edible agricultural products.

Furthermore, when combined with the big data technology, the enormous resources in the blockchain platform can be mined for insights to improve government services delivery.

IV. THE DIFFICULTS OF APPLYING BLOCKCHAIN TECHNOLOGY TO E-GOVERNMENT IN CHINA

A. The Cost of Establishing a New Blockchain-based Platform

In the case of e-government, the different strategies regarding economic investment in science and technology might represent not only a government's attitude towards new technology and innovations (and possibly towards a new form of public administration), but also various aspects of the region's context, such as economic abundance and technological resources. Different regions in China are distinct from each other in the above areas, which largely explain the imbalance of e-government development across regions.[9] The establishment of a blockchain platform involves a number of different systems and organizations, and problems such as time and expense will hinder its construction. It may be easier for the developed regions of China to invest in the new application of blockchain technology and improve e-government development; in other regions, the government may find it is hard to justify the cost of this new platform, even though it will benefit the local government in many areas.

Furthermore, there are already different kinds of public services platforms in China now, including the "Online Services Hall," among others. How to make full use of the existing systems and how to avoid redundancy while developing a new blockchain-based platform are just two important issues that need to be further examined. Otherwise, it may produce duplications with existing public services platforms, which would not only be wasteful, but could also lead to confusion in providing public services and a concomitant loss of trust in government.

B. The Long-term Preservation of Blockchain Platform Records

Blockchain technology has only recently begun to be used for applications beyond crypto currency. While it has many exciting potential uses, it does not guarantee reliability of information and would have several limitations as a long-term solution for preserving trustworthy digital records.[10] In a blockchain system, records as such (as opposed to their hashes) would have to either reside in the blockchain or should be moved to a separate environment or system for long-term preservation. The question of where and how to store the records associated with the blockchain platform is a problem that must be solved if the blockchain system is applied.[11] In Chancheng, the data in blockchain-based applications is stored in the cloud. The long-term preservation of this data is not distinct, however. The records of public services platforms are valuable evidence of governmental, economic, and social activities, and thus they should be transferred to the archives and appropriately maintained for long-term preservation. If such records cannot be preserved appropriately, civil rights, legal evidence and social memory could be damaged irretrievably.

C. The Information Security of Blockchain Technology

Blockchain aims to change the way that the authenticity of records is established, from reliance on a trusted third party to a system-based mode of establishing authenticity.[12] At present, the biggest danger actually comes not from system vulnerabilities, but from blind trust in the blockchain on the part of blockchain developers, lawmakers, law enforcement and the general public. This trust relies exclusively on the technology, rather than management, to make sure the system is trusted and the records in the system are reliable.[12] It cannot be guaranteed that technology will never make a mistake, however. And if the blockchain platform was widely used in e-government for systems that contain essential information, one mistake may lead to serious consequences.

D. Management Responsibility of the Blockchain Platform

The blockchain platform requires the cooperation of multiple institutions. Taking the Smart Farmers Market from Chancheng District as an example, we can see that different institutions provide the records at each stage from production and transportation all the way to the point of sale. How to ensure the whole process will be recorded and maintained appropriately, and determining which institution should take responsibility to manage the system and its records is a question that should be answered prior to establishing the system.

V. THE SOLUTIONS OF APPLYING BLOCKCHAIN TECHNOLOGY TO E-GOVERNMENT IN CHINA

A. Standardization

The lack of a common blockchain platform and application standard is one of the most important reasons why the initial investment of time and money to develop an e-government blockchain platform is so high. Clarifying the basic concepts, processes, and standards in the application of blockchain

technology in e-government in China can help to improve the awareness of blockchain technology, unify the basic develop platform and application programming interface, promote the interoperability of multiple blockchain systems and perfect the business processes required. This will reduce costs and improve customer satisfaction, and also expand the field of application so that both the developed and underdeveloped regions in China will be able to apply blockchain technology to e-government platforms, and in turn narrow the gap among these regions and promote public services in China.

B. Collaboration

Technology institutions need to consider not only the work involved in developing blockchain platforms, but also the work required for their long-term operation. This means that prior to establishing blockchain platforms, governance institutions, technology organizations, archives and other involved institutions should participate in discussions about both start-up and maintenance, with each applying their professional knowledge of different areas to make the system and management procedure useful and reliable. For example, from the perspective of archives, a blockchain-based platform must support the trustworthiness of records; thus, archival expertise should be brought to bear from the start to ensure the reliability and authority of this platform, and to address issues of long-term preservation, management systems, processes and methods. This interdisciplinary approach will help the government protect valuable records and cultural heritage.

C. Management System

Although technology can improve the quality of government services, the management system remains critical in successful implementation. The government is ultimately responsible for the governance of the blockchain platform for public services. Since this system includes multiple organizations, it is necessary to clarify the responsibilities of each participating organization, the end-to-end processes, and the overarching framework in which they will all work.

D. Security

Security and privacy are the main attributes of a decentralized transaction environment.[13] The core goal of records management is to make sure records can be trusted. The security system of a blockchain platform should include physical security, data security, application systems security, secret key security and risk management. Building a secure system can maximize protection of the normal operations and protect the trustworthiness of records within the platform.

VI. Conclusion

Blockchain technology could change our paradigm for trusting records; instead of turning to trusted third parties, such as government registries, for evidence, we could find ourselves turning to the blockchain.[12] It has the potential to change Chinese society in many aspects. Its development still has both opportunities and risks, however. To date, the lack of mature application in other fields remains the main problem in its application. There is still a need for blockchain enterprises and market managers to actively cooperate with each other, implement blockchain applications, and introduce innovative solutions.[9] Therefore, the experience of the Chancheng government could be the first step in the development of blockchain-based public services. Chancheng's experience reveals that blockchain technology can help the government develop an individual credit system in society, not only for citizens but also for institutions, and thereby improve the provision of services, governance, and government credibility. However, this will not be an easy goal to achieve. The development of blockchain technology in e-government still needs discussion in different aspects; this technology offers a new method for delivering and managing public services, and there remains a need to establish standards, deploy solid management systems and ensure adequate security to make sure the services and platform are reliable, authoritative and supportive of long-term preservation.

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