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Using block chain to drive the transformation of digital cultural heritage resources into digital assets in China

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Digital cultural heritage resources in China are being transformed into digital assets. Protecting the intellectual property of these resources requires creating digital identity and certificate storage methods that are compatible with different management needs. Based on the latest policies on integrating cultural heritage, science and technology, and block chain development in China, this paper summarizes the key current issues related to protecting the intellectual property of digital cultural heritage. Based on that, the paper analyzes the innovative development cases of applying block chain technology to digital identities and the certificate storage of cultural relics. This paper explores the creation of a digital identity and certificate storage management system for cultural relics, based on block chain and multi-modal data, the innovative development of the asset trust mechanism formed by digital cultural heritage on the Internet of value, and the driving effect involved in transforming digital cultural heritage into digital assets.

Keywords: Block chain, digital cultural heritage, digital asset, intellectual property, digital identity and certificate storage

1. Introduction

In recent years, China has begun to comprehensively and systematically explore and use the many values associated with cultural heritage resources, for example the tourism industry value of a historical building, to strengthen cross-disciplinary services and capacity to reuse cultural relic information. Through digitalization, cultural heritage enters the Internet in different data and information formats, forming tremendous cultural resources. To develop further, the cultural industry needs to reuse these resources to develop new products, expand new markets, create new values, drive the transformation of digital cultural heritage from resources into assets, and promote the intellectual property of digital cultural heritage. However, the intellectual property market of cultural industry in China is not currently standardized, and there remain problems with respect to the confirmation of rights, the rights of use, and the right to safeguard cultural heritage intellectual property management.

For example, innovative technologies are needed to manage credit in the collection and trade of folk cultural relics. This is needed to improve the trust and value management mechanism. This paper considers recent perspectives with respect to China's block chain and policies and their impact on the intellectual property of digital cultural heritage resources, as well as their innovative technologies and services. In combination with the latest development cases, this paper analyzes the driving effect of block chain on the transformation of digital cultural heritage resources in China into digital assets. (The cultural heritage discussed in this paper represents tangible cultural heritage resources.)

2. The policy context of guiding cultural heritage into cultural assets through intellectual property and block chain technology

Block chain technology can transform digital cultural heritage resources into digital assets. This can transform the different kinds of information about history, humanity, science and technology, and art contained in cultural heritage resources into the direct point-to-point delivery and exchange of value through the Internet, based on digital intellectual property. This allows the digital value of cultural heritage to flow freely on the Internet. The core of managing digital intellectual property includes certificate storage, the confirmation of rights, the safeguarding of rights, and copyright trading for cultural heritage resources. The key is verifying authenticity and a trust mechanism. The unique technologies of block chain, including the chained data structure, encryption algorithm, and smart contracts make it advantageous in managing digital intellectual property [6].

Realizing the value of the delivery and exchange of digital cultural heritage resources with other relevant industries is key for transforming resources into assets. Digital assets have ownership embedded in binary data, which are generated and stored in computers, smartphones, digital media, on the Cloud, and in other devices [27]. Zhu noted that digital assets are data assets that are defined as valuable, quantifiable, and readable data sets in cyberspace. These assets have data ownership (right of exploration, right of use, and ownership) [31]. The value attribute of cultural heritage includes cultural value and economic value. The cultural value is the essential attribute, and the economic value originates from the fact that cultural heritage can promote production in other relevant industries [8].

Tangible cultural heritage resources include movable cultural relics and immovable cultural relics [16], which belongs to an objectified form of cultural capital [1]. Different data and information are extracted from cultural heritage resources, which are stored, processed, and analyzed. Then, they are classified, presented, and interpreted through different media, forming knowledge and content useful to people and society. The main content and forms of digital cultural heritage resources include "objects using rich media, cross-texts, images, sounds, maps, videos, and many other formats [7]." Digital cultural heritage resources are the product of virtual cultural production [5], which can be licensed for exhibition, education, cultural and creative industries, business, and other fields. The resources can be reused through copyright transactions, generating new products and creating new value. This forms the market and value systems involving transaction, circulation and virtual currency [5]. This makes the digital cultural heritage resources the nodes of "b-webs," [23] realizing the transformation from resources into digital assets.

Therefore, establishing the intellectual property (data proprietorship and ownership) of digital cultural heritage resources is the key to realizing this transformation. However, there are several current problems in managing the intellectual property of cultural heritage in China. These include a dependency on the traditional methods of copyright protection on authoritative third-party certification, the lack of diversified information records in identifying cultural relics, a lack of a measurement standard for establishing the value of cultural relics, the lack of precise technologies and methods to confirm rights, and the lack of accurate tracing methods for traditional transaction paths. These management problems create obstacles to the trade and circulation of digital cultural heritage. As such, technological innovations need to be developed with respect to the basic data management of cultural heritage resources. These innovations would improve the intellectual property management of digital cultural heritage resources.

Since 2016-2018, the Chinese government has attached great importance to improving the capacity of science and technology to spread and utilize the value of cultural heritage. The government has licensed intellectual property to other related industries to enhance the core competitiveness of the cultural service industry. This has changed the presence of the large surplus in the cultural manufacturing industry and large deficit in the cultural service industry in China [18]. The protection and inheritance of Chinese cultural heritage resources have been developed to support their reuse and the creation of new value. There have also been proposals for requirements related to technical and mechanistic innovation, laying a solid foundation for the innovation and development of block chain technology to manage the intellectual property of digital cultural heritage resources.

In *Guidance on Further Strengthening the Work on Cultural Relics* [24], __ proposed the advancement of the integration and innovation of cultural relics protection and modern information technology. *The Three-Year Action Plan for* "*Internet + Chinese Civilization*" [11] ___ required an open and shared system for managing cultural relic information resources, forming rules and regulations on authorizing operations, and protecting intellectual property. *The 13th Five-Year Plan for the Development of Cultural Relics Undertakings in China* [21] required the strengthening of the formulation and revision of general standards for collecting, processing, storing, transmitting, exchanging, and servicing the digital resources of cultural relics. *Some Opinions on Strengthening the Reform of the Protection and Utilization of Cultural Relics* [4] emphasized the perfecting of the asset management system of state-owned cultural relics resources, and establishing a dynamic management mechanism for the assets associated with cultural relic resources.

In particular, *China's* "*13th Five-Year Plan*" *for Scientific and Technological Innovation on Cultural Heritage Protection and Public Culture Service* [12] emphasized the multi-modal feature integration of digital cultural heritage information, to realize the transformation of cultural relics into digital assets from resources. The Plan required that research and development be conducted on the credit management services collected in transactions. This built the R&D framework and application for the development of a block chain. In terms of recognizing the value of cultural relics, a policy was proposed to study "the index system reflecting different information about different cultural relics and the corresponding methods of extracting, storing, processing and analyzing information".

With respect to protecting and restoring cultural heritage, it was proposed that R&D be conducted on intellectual property protections, tracing technologies, and a system that addressed a full chain

of collection, storage, management, and application. In terms of public culture services, digital cultural resources should be integrated in a refined manner to "solve the technical problem of transforming public digital cultural resources into 'materials' from 'resources,' … and realize the multi-modal feature integration based on cultural content". In terms of the copyright protection of cultural heritage, key technologies related to credit management services were needed to collect and support the transactions of folk cultural relics [12].

A block chain has the technical feature of storing data permanently without the possibility of data falsification. Its development has attracted the attention of the Chinese government, with applications that support direct point-to-point value delivery and exchange. The concept of block chain was proposed in a white paper about Bitcoin [14] in 2008 and it has attracted extensive worldwide attention ever since. Block chain adopts a decentralized infrastructure and distributed storage consensus technology. From an accounting perspective, block chain is a distributed ledger technology or system. From a protocol perspective, block chain is an Internet protocol that addresses the data trust problem. From an economic perspective, block chain provides an Internet of value that can improve the efficiency of cooperation. The Chinese government accelerated the application and development of block chain technology through its policy orientation from 2016-2019.

The *White Paper on the Development of China's Block Chain Technology and Application (2016)* [10] first proposed a standardized system framework and technology development route for a block chain in China. In *The "13th Five-Year Plan" for National Informatization in China* [25], block chain was first included in China's strategic cutting-edge technology. *A Three-Year Action Plan for the Development of Cloud Computing* (*2017-2019*) [13] proposed conducting R&D and industrialization on block chain. The *Notice on the "13th Five-Year Plan" for National Informatization in China* [26] proposed that a sound block chain standard system should be actively established to accelerate its application. The *Administrative Regulations on Block Chain Information Service* [15] proposed the strengthening of oversight over block chain information services providers and users. The *Password Law in the People's Republic of China* [17] proposed that China should establish and perfect a standard system for commercial passwords. Block chain has been applied in the domains of industry, logistics, post, education, publishing, and government affairs in China. As such, relevant management mechanisms are available.

The Chinese government's policy orientation on digital cultural heritage and block chain provides an innovative direction for cultural heritage value utilization and public and market services. The next part of this paper explores the core problems associated with intellectual property protection with respect to digital cultural heritage resources and the corresponding development direction of block chain technology.

3. The creation of digital identity and certificate storage methods compatible with different management needs are required to protect the intellectual property of digital cultural heritage resources

In today's block chain development, one pressing core problem related to protecting the intellectual property of digital cultural heritage resources is the methods for preserving and managing different

complex information and data of cultural relics in a unified manner. This includes cultural relic value, transactions, management information, and multi-source heterogeneous data. The goal is to prevent the information or data from being deleted maliciously or falsified. The problem is specifically analyzed as follows:

1. The intellectual property of digital cultural heritage has many data sources and come in different structures and forms. These need to be integrated into a data set for unified management.

The intellectual property of digital cultural heritage resources involves literary, artistic and scientific works, inventions in all fields of human endeavor, and scientific discoveries [28]. The extracted data, including name, function, excavation time, size, GPS coordinates for excavation and preservation locations, shape and status, structure, material, and texture, may be in different forms and structures. Technology assistance is needed for the different data to be compatible. In this way, these multi-source heterogeneous data can be integrated into a data set to meet the reuse requirements from different industries.

2. The complex value information, management information and transaction information of cultural relics complicate the right of confirmation, the right of use, and the safeguarding of the digital intellectual property.

Technological innovation is required due to the diversification of cultural relic value information, to ensure the standard evaluation of its intellectual property. Different perspectives bring different requirements related to the intellectual property of digital cultural heritage resources in different fields, such as exhibition, education, cultural and creative industries, and commerce. Standards differ for evaluating the historical, humanistic, artistic, aesthetic, economic, and other values of cultural relics. Technological innovation is required to evaluate different value information in a standard manner, to facilitate the transformation from resources into assets.

The multiple management of cultural relics makes it complicated to confirm, use, and safeguard the ownership of cultural heritage. As such, technical assistance with intelligent authentication is required. Many units at different levels are involved in managing cultural relics in China, leading to diversified management subjects and complicated management information. As a result, there is an unclear distribution in the ownership, administrative and management rights of cultural heritage resources.

The trading market of cultural relics is complex, and identifying or transactional information are at risk of being falsified or deleted. This makes the market dependent on third-party certification, and requires management methods that can trace all recorded transaction information. China plans to relax restrictions on the collection and trade of folk cultural relics, and in 2020, it will start to conduct a pilot test to relax the legal circulation of folk cultural relics [20]. It would be difficult for the existing traditional way of recording the transaction of cultural relics to meet today's complex market management needs.

Therefore, block chain technology provides a way to save and manage different information about cultural relics to support digital cultural heritage. This method can establish the digital identity and system in a standardized and multi-modal manner, and can store certificate information, such as

ownership. This approach can meet the management requirements that the information data be compatible with multi-source heterogeneous data, multiple values, and multi-management; that their transaction be traced; and that they can be permanently stored but not falsified. The block chain system manages the intellectual property of digital cultural heritage, serves as the credit carrier for transactions and circulation, and forms an asset trust mechanism in the value network, where value can be recognized, shared, and managed by all.

The intellectual property management system of the digital cultural heritage established by the block chain is based on the unique internal cultural information of cultural heritage and the external copyright information structure. The goal is to protect and use its intellectual property in a safe manner. Based on the theory of block chain technology, the basic data related to the cultural heritage are recorded into the block chain, establishing a safe and effective intellectual property management system from bottom to top.

1. As digital assets, the multi-modal digital identity and certificate storage of cultural heritage show a one-to-one correspondence relationship with its original relic.

Similar to a system where a citizen's identity record includes the facial image, fingerprint, birth date, and other characterized information of the identified object, cultural heritage information also has structural features, including its unique internal cultural information. This allows for the establishment of the corresponding modal digital identity mechanism, and the storage of copyright and ownership information. This includes comprehensive multi-modal feature information of the identified object. The comprehensive feature information helps identify cultural relics, and provides basic data for the fields of exhibition, education, cultural and creative industry, and commerce. This supports a standard evaluation of values. Thus, the digital identity of the cultural heritage resource needs to be absolutely safe, and cannot be falsified after being generated. This requirement is highly consistent with the security design of block chain. As a decentralized distributed structure data recording system, block chain relies on a single hash value for a block and a series of core security designs based on cryptography, such as secure authentication, end-to-end encrypted information transmission, and the most consensus mechanisms. These mechanisms ensure that the digital information registered in the block chain system will not be deleted maliciously or falsified, satisfying the requirement of the absolute security of the cultural heritage digital identity.

2. Digital identity and certificate storage can solve existing problems related to the confirmation of rights, the right of use, and can safeguard rights for the intellectual property of digital cultural heritage resources.

Traditional methods of protection and utilization rely on the authoritative third-party authentication. These methods have many disadvantages, such as the fact that circulation security and the effectiveness of digital content cannot be guaranteed. Declaring the ownership of block chain nodes through the certificate storage of block chain technology saves significant time compared to traditional rights confirmation. The decentralization and encryption attributes of block chain make intellectual property more resistant to destructive loss or attack by hackers. In addition, circulating the intellectual property associated with digital cultural heritage resources on the Internet are also recorded and traced in real-time when needed. The block chain automatically records information and rules through programmed algorithms. This provides definite and clear rights of ownership, and

helps establish direct point-to-point communication between the demand side and the supply side. This reduces intermediate links; accelerates the matching of supply and demand and transfers; and rapidly determines infringement acts and subjects.

3. The appreciation of digital cultural heritage can be realized through block chain.

As a digital asset, the circulation of the digital identity of cultural heritage resources is well controlled in the information field. This supports the exchange of value, which is highly consistent with the unique transactional design offered by block chain. For example, after the copyright of a painting is made into a digital encryption certificate, in the digital economic ecology of calligraphy and painting, the reputation and price will continuously increase through value appreciation, evaluation, praise, auctions, and other activities at different nodes [29].

These factors make block chain technology very suitable for managing the intellectual property of digital cultural heritage resources. The main development cases for using block chain to manage the intellectual property associated with digital cultural heritage resources in China currently include the multi-modal digital identity construction device of a matter input block chain. The method was developed by a team of Tsinghua University in 2018 [3], which used block chain technology to store and share the digital characteristics of cultural heritage. A second method, developed by Liu in 2017, involves a kind of historical relic and artwork numeral, based on a block chain technology deposit card [2]. The next part of this paper analyzes two cases to explore and develop the system for managing intellectual property associated with digital cultural heritage resources based on block chain.

4. Establishing a digital identity and certificate storage management system for cultural relics based on block chain and multi-modal data

In the two cases, a block chain was used to record multi-modal data about cultural relics to manage the intellectual property. In both cases, one unique fixed hash value, capturing the digital information and documents related to a cultural relic was obtained using a hash algorithm. The value was stored in a block chain, to be integrated as the digital identity or certificate storage in the block chain of cultural relics. The block chain became the management tool for the intellectual property of the digital cultural heritage resource. The Tsinghua University team collected and recorded three kinds of basic data on morphological structure, material and texture, and basic profile of cultural relics. The data were then combined to form a multi-modal digital identity. Liu integrated the three kinds of data on integrated persons (ownership subjects), material objects (cultural relics and artworks), and physical data (pictures, HD scanning, 3D data model) into the block chain to form digital certificate storage. Both cases can be used to manage the intellectual property of digital cultural heritage resources from different perspectives to solve problems related to ownership confirmation, security, identification, and loss prevention in managing cultural relics.

« The multi-modal digital identity construction device of matter input block chain and method » includes two parts: creating data information files and recording data to the block chain to create digital identities.

1. Creating multi-source heterogeneous data information files of digital cultural heritage resources

By integrating multi-source heterogeneous data into high-precision 3D reconstruction, hyperspectral color texture analysis, and collection technology, the multi-modal data on the form, structure, material, and texture of a cultural relic can be collected and recorded. This establishes a relatively comprehensive multi-modal digital identity information system for cultural heritage resources.

1.1 Creating a 3D-configuration modal identity

The 3D configuration is the most intuitive and accurate record of cultural relic forms. This approach can provide basic configuration data for a virtual reality exhibition. In the case that the identified object changes, it can provide comparison information of the original form, helping with damage assessment and guiding repairs. Different 3D modeling techniques can be used based on the different categories of the scanned objects.

For objects with a high scanning accuracy, moderate object size, and low specular reflection, a 3D model is established using a structured-light camera [30]. Using the different settings of the structured-light camera allows for modeling accuracy at a scale of 10-microns. 3D imaging with a structured-light camera is used to project a structured light onto the object surface, and a video camera is used to receive the structured-light pattern reflected by the object surface. The received pattern is bound to be deformed due to the three-dimensional shape of the object. This makes it possible to calculate the spatial information of the object surface through the position and degree of deformation of the pattern on the video camera.

A 3D model is established using a laser scanner for objects having surface materials with strong specular reflection. 3D laser scanning technology rapidly re-establishes the 3D model, covering the drawing data on line, plane, and cube of the measured object. The system records the 3D coordinates, reflectivity, texture and other information of a large number of dense points on the surface of the measured object, based on the principle of laser ranging.

1.2 Creating the modal identity of surface material and texture

Surface material and texture information also provide important identity information about cultural relics, and record the surface material composition of cultural heritage resources with high fidelity. Under the premise of not damaging the collected objects, hyperspectral data about cultural heritage resources are used as the data showing the information on its surface material. The spectrum is considered the “fingerprint” for identifying substances. The shape, size and other information of substances can be seen using optical imaging with the naked eye. The composition information of substances can be obtained through spectral analysis [19]. Hyperspectral imaging can also be used to obtain more abundant and detailed composition information about the substances. A hyperspectral camera is used to capture images of the object surface to obtain the spectral data of each point on the images. When the images are superimposed, an image cube forms in the three-dimensional space. A spectral curve is formed by connecting the values for hundreds of digital images corresponding to each pixel. The spectral information reflected by different substances or substances of different ages will differ, which will be manifested as fingerprint spectrum unique to the substance.

2. Creating the modal identity of the basic profile

2.1 Synthesizing three kinds of modal data into digital identity

In addition to recording 3D model data and surface material data of cultural relics, basic profile data on the recorded objects are also collected synchronously. These include the name, size, function, excavation time, GPS coordinates for excavation and preservation locations, timestamp for 3D model building, serial number of equipment for 3D model building, timestamp for hyperspectral imaging, serial number of equipment for hyperspectral imaging, and basic information about the scanning operator.

The three modal identities above are synthesized into a unified record, generating the multi-modal digital identity of the cultural heritage resource.

2.2 Using the double-deck block chain to record digital identity data

A double-layer block chain management system structure is designed based on the features of multi-modal digital identity data of cultural heritage. A single file of the multi-modal digital identity of cultural heritage usually contains large amounts of data, making the data contained by the overall digital identity also very large. These data are not easy administered on the privately-owned chain. For the sake of information security and the non-publicity of some information, a double-layer block chain structure with the combination of privately-owned chain and publicly-owned chain is designed.

After the identity for a single tangible cultural heritage is created, its identity file allocated with a digital signature is stored in a distributed big-data storage platform. The hash values for the digital signature, or identity file, are generated and mounted to the publicly-owned chain for permanent recording and management. Then, using the identity data aggregation module, the hash values for each newly generated digital identity of cultural heritage and the existing hash values are aggregated into a file. Through the hash processing module, hash processing is conducted on the aggregated digital identity file of cultural heritage objects. The hash processing results are considered to be the overall data fingerprints of the current privately-owned chain, which are mounted to the publicly-owned chain administrative unit. For example, the multi-modal identities are managed using the Tencent block chain application basic platform (Trust Platform) with high availability and expandability, in combination with its underlying block chain platform (Trust SQL) and distributed big data storage system (BigChainDB). The upper application service layer (Trust Application) is used to support multi-modal identity verification, remote authorization, virtual exhibition, and other practical application scenarios [22].

« A historical relic and artwork numeral based on a block chain technology deposit card » is one method for achieving the digital certificate storage of cultural relics based on block chain technology. There are three parts to this method: inputting information on cultural relics, generating hash values for the information and inputting them onto block chain, and comparing the hash values for verification.

1. Inputting information on cultural relics and identity documents

The ownership applicant should provide 2 types of information for the registered cultural relic. These are input into Object Storage Service. One type of information is the basic information about the cultural relic; the other type of information is the digital information and digital documents about the identity of the cultural relic. The specific contents of the two types of information include: the picture file, identity file, 3D file, video file, and feature file of the cultural relic; and the ownership applicant's digital identity file. The two kinds of multi-modal original data are then stored separately.

2. Generating hash values for the two kinds of data and inputting them into block chain

The Chinese state standard algorithm is used to generate a unique hash value for the two kinds of data. The unique hash value representing the cultural relic is then registered on the block chain. After successful registration, the block height, timestamp, and other block information are recorded.

3. Comparing hash values to verify the consistency of cultural relic information

When the ownership subject and digital information of cultural relics need to be verified, the two kinds of original information stored in Object Storage Service will be read. This generates hash values again, which are compared with the hash values recorded in the block chain. Consistent hash values indicate that the ownership subject and digital information of cultural relics have not been modified [9].

In both the methods above, the multi-modal data of cultural relics are stored in the form of a block chain. The certificate storage, the created digital identity, and the generated hash values can all be used to record and manage different complex information and data related to cultural relics in the form of ledger. This approach satisfies the requirement that those data can be compatible with multi-source heterogeneous data, multiple values, and multiple management; that their transaction can be traced; and that they can be permanently stored and not falsified. This forms a management system for digital identity and certificate storage of cultural relics based on the block chain and multi-modal data. This improves intellectual property services and drives the transformation of digital cultural heritage resources into assets.

5. Conclusion

Establishing a digital identity and certificate storage management system for cultural relics based on block chain and multi-modal data provides a method to address problems related to the rights of confirmation and use, and the right to safeguard the intellectual property of digital cultural heritage. Data authenticity assures that the technology and trust mechanism are suitable for solving problems associated with in copyright protection. This facilitates copyright trading and reuse, creating new value and driving the transformation of digital cultural heritage into assets.

1. Establishing a credit model for intellectual property of digital cultural heritage based on people's trust in block chain technology

Digital intellectual property can be directly uploaded into the block chain. Ownership is determined through machine algorithms and cryptography principles. The intellectual property data uploaded

into the block chain can only be written and read. Data cannot be falsified, due to the characteristics of decentralization technology. Traditional confirmation of rights requires third-party certification; each cultural relic identification depends on professional experience. The block chain enables the transformation of intellectual property trust relationships between people and people into relationships between people and technology. This has changed the trust mode centered on the third party in the traditional digital economy, saving confirmation time.

2. Integrating different multi-source heterogeneous data of digital cultural heritage into a digital identity to clarify ownership

The aggregation hash processing module allows for the full integration of physical data, basic information, and ownership information of cultural relics. The resulting digital identity mechanism for digital cultural heritage contains as many multi-modal information features as possible for the identified object. The chain storage and contract mechanism can facilitate the clarification of intellectual property ownership.

3. Making the circulation and transaction records of intellectual property traceable

A block chain can completely record each circulation or transaction of intellectual property of digital cultural heritage. All the records are traceable, making it possible to rapidly determine infringement acts, time, and subjects. This makes safeguarding the property more convenient.

The three points above can help solve credit management and other problems in the collection and trade of folk cultural relics.

4. Realizing direct point-to-point value delivery and exchange of intellectual property

The explicit ownership of intellectual property makes it convenient to use rights associated with the heritage of digital cultural. The demand side and the supply side can directly deliver and exchange value in a point-to-point manner through the Internet. This reduces transaction cost and greatly improves transaction efficiency.

5. Intelligent transactions enable intellectual property to serve other fields in a low-cost manner and create new value.

Digital intellectual property transactions are conducted in an intelligent manner, which discards institutional constraints or dependency on third-party organizations. The allows for the reuse of intellectual property in exhibitions, education and the cultural and the creative industry, commerce, and other fields in a more efficient and secure manner to create more new value with low-cost services.

6. Building a digital identity and certificate storage management system for cultural relics using block chain and multi-modal data increases the convenience for professional institutions in conducting remote research about cultural relics using the Internet.

Professional institutions can be authorized to hold the intellectual property of digital cultural heritage, enabling the institutions to study the physical data, basic information, and ownership

information of cultural relics through the Internet. The institutions can also check or repair the damaged cultural relics based on database information.

With rich cultural heritage resources, different types of cultural industries, and large cultural consumer groups, China has a large space within which to transform cultural resources to assets. Managing the digital identity and certificate storage of cultural relics using block chain and multi-modal data will provide an innovative intellectual property management mode to transform digital cultural heritage from resources to assets. This requires adjustments in the governance rules developed by China to regulate the intellectual property market in the cultural industry. The mechanisms involved with value exchange and delivery changes through block chain and the Internet of value. This optimizes the transformation from digital cultural heritage content into cultural industry value and enhances the international competitiveness of China's cultural services, with intellectual property at the core.

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